300-95-1/v.1B

DCA CIRCULAR 300-95-1

DEFENSE COMMUNICATIONS AGENCY

PLANNER'S GUIDE TO FACILITIES LAYOUT AND DESIGN FOR THE DEFENSE COMMUNICATIONS SYSTEM PHYSICAL PLANT

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VOLUME 1B

DCS SWITCH AND CONTROL FACILITIES

D5.104:

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEFENSE COMMUNICATIONS AGENCY
WASHINGTON, D. C. 20305

DCA CIRCULAR 300-95-1

29 July 1985

DCA FACILITIES

A Planner's Guide to Facilities Layout and Design for the Defense Communications System Physical Plant

1. Purpose. This Circular provides planning information, guidance, and criteria for the development of facility renovation, expansion, alteration, or new construction projects planned for the worldwide DCS physical plant.

2. Applicability. This Circular applies to Headquarters, DCA; DCA field activities; and military departments responsible for the planning and acquisition of DCS facilities.

3. Contents. To facilitiate the use, updating, and expansion of the material covered, the Circular has been organized into three general divisions.

a. Volumes 1a and 1b provide the bulk of the information neccesary to plan specific DCS facility types. All of the theoretically ideal data which needs to be considered at any of the stages of project development is contained in these first two volumes.

b. Volume 2 contains generic information which may additionally apply to specific facilities, depending on their location and importance within the DCS.

c. Volume 3 provides a series of case studies to demonstrate ways of applying the "ideal" guidance contained in the first three volumes with the practical limitations of the world in which the DCS must plan and operate.

4. Document Improvement. This is intended to be a living document, one which will mature with the evolution of the DCS. To accomplish this goal, comments or suggestions for improvement of the contents are encouraged, and should be directed to the Defense Communications Agency, ATTN: Code B212, Washington, D. C. 20305.

FOR THE DIRECTOR:

DARLENE K. BREWER
Colonel, USAF
Chief of Staff

OPR: B212
DISTRIBUTION: Special

FOREWORD

This investigation was performed by the Facility Systems Division (FS), of the U.S. Army Construction Engineering Research Laboratory (USA-CERL), Interstate Research Park, P.O. Box 4005, Champaign, IL 61820, for the Defense Communication Agency under Order No. HC 1001-2-40152.

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INTRODUCTION

1 Purpose of These Documents

The Military Departments (MILDEPs) operate Defense Communication System (DCS) facilities throughout the United States and the free world. These facilities must provide a high level of mission responsiveness to enhance the specific activity efforts of military service personnel. Also, since DCS requirements and communication equipment are constantly evolving, much flexibility must be designed into each facility.

The Defense Communications Agency Defense Communications Engineering Command (DCA/DCEC) desired to implement an optimal workstation and facility layout design handbook to assist planning, programming, and design personnel in increasing the environmental satisfaction of all DCS facility users. To this end, the U.S. Army Construction Engineering Research Laboratory (USA-CERL) was requested to survey, evaluate, and design prototype optimal workstations and total facility layouts for all personnel and equipment requirements. The objective of this effort was to develop optimal prototype space utilization and habitability designs for all DCS facility types. A research plan was started to: (1) determine all generic communication areas and space requirements, (2) analyze the mission responsiveness issues (efficiency, privacy, security, etc.) for the various workstations, (3) design an optimal layout plan for each space type, and (4) provide planning, programming, and design documents to assist in the development of all future projects. These documents would aid in designing new construction and in renovating existing buildings to meet current accepted requirements for the DCS facilities.

The handbook has been separated into three volumes, 1A, 1B, and 2. Volumes 1A and 1B contain facility information obtained from personnel who operate and maintain the DCS. Using input from several (7 to 16) persons about the same space, generic requirements necessary to accomplish the DCS activities in that space were determined. Therefore, Volumes 1A and 1B contain mostly new information from persons with several years' actual experience in a variety of existing DCS facilities and circumstances. Volume 1A has information about each space of each transmission facility type and Volume 1B has similar information about the spaces in switch and control facilities. Volume 2 contains information about extenuating conditions that also must be considered as part of the requirements for responsive DCS facilities--survivability, security, climate, construction components, site utilities, and similar factors. Most Volume 2 information came from existing documents (approximately 200) approved for use in DCS facility planning, programming, and design. All extracts from these documents are identified by a number at the end indicating the document and the page or section from which the extract was taken, e.g., "(9) 153" indicates that the extract came from page 153 of the source numbered 9 in the Bibliography.

These documents are designed to serve many types of facility project decision makers. Specifically, they are intended to aid facility planners, programmers, and construction project designers; they also should help DCS facility commanders to evaluate their existing facilities. These users require several types of facility information. Thus, information in this handbook can be used for specific design decisions for new construction or renovation, and for evaluation of an existing facility. For the first type of decision, once a communication requirement has been determined, these documents have the information required to determine the total area and separate spaces for operational sections in each major organizational unit. Next, optimal room areas are indicated to assist in dividing up the allocated square footage of each organizational unit. Finally, the individual workstations can be designed considering the demands on communications, electrical, and mechanical systems. For the second type of decision, this information is intended to allow DCS facility commanders to develop a continuing evaluation program for their facilities. The information is in a format that describes optimal workstation requirements, criteria, and guidance layouts; individual units can work toward these in a series of small-scale operations and maintenance improvement projects to improve the total facility operational effectiveness in performing the DCS mission.

These documents also provide DCS facility site planning concepts. The Department of Defense (DOD), DCA, and MILDEP communication command personnel can use this information to determine construction and/or equipment procurement needed to carry out the total communication mission. Readers interested in developing functional requirements for the 1391 documentation of a construction project should focus primarily on activity, personnel, equipment, and requirements columns for each space and on the space relationship diagram for each facility type. Readers interested in developing project designs should attend to the criteria, guidance, building components, and systems columns for each space and to the prototype total building design at the end of each facility type section.

2 Organization of the Information

The information in these documents is organized into data that apply to the following:

a. Individual workspaces within organizational subsections of a communication facility.

b. An entire DCS facility as an integrated whole.

c. Recommendations for options to accommodate the special operational and survivability requirements for an entire DCS site.

The information is formatted space by space. For each component space, 10 types of data are presented:

1. *function*--statement of the overall reason for the space in a facility.

2. *policy and sop* (standard operating procedures)--regulations that define what must be done and how it should be done. The information is taken from documents such as service regulations, field manuals, and unit or installation procedure statements.

3. *issues*--data indicating how the work activities can be improved by alternative environmental conditions or trade-offs related to different ways of accomplishing functions at the facility.

4. *assumptions*--statements related to each issue; these recommend how the facility should be designed for optimal mission responsiveness over time. (Not all issues have these recommendations.)

5. *activities/personnel/equipment*--specifically what the functional operations are, who does them, and with what equipment that is not part of the building.

6. *requirements*--qualitative statements about what the building must be to provide optimal occupant/environmental interaction over time.

7. *criteria*--statements developed directly from the requirements list; these provide quantitative and/or qualitative measures to determine the proper design solution for an interactive building.

8. *guidance*--statements, sketches, and diagrams providing realistic advice based on design experience and case studies related to similar building spaces.

For each DCS facility type, a space relationship diagram is also presented to show the desired optimal adjacencies of all workstations and spaces for the particular facility. All information contained in the 10 categories is generic and relates to functions at DCS communication facilities. "Generic" means these functions are generally operational for any communication facility, no matter which military unit is involved. In progression, the separate spaces first were generated in terms of relating policies and SOP to the activities, personnel, and equipment required to accomplish a specific function. Next, requirements and criteria for the facility workstations were developed. Finally, planning concepts in the form of potential guidance related to specific building or exterior operational areas were generated. Thus, the requirements, criteria, and guidance provide the "optimal information" for mission activities. Relevant information about operation and maintenance (O&M) practices were obtained from discussions with military units, communication industry operators, construction researchers, and reviews of current periodicals and research literature. The information has been integrated into a six-page format for each functional area so that all information can be seen together, starting with the policies related to a particular function through space layout sketches and building component and systems recommendations. This organization should permit ready access and easy incorporation of applicable information into planning, programming, and design documentation by the various decision makers who develop DCS facilities.

3 Future Development of the DCS

As DCS changes to meet future demands, the transition will reflect an evolution toward current technology and concepts as well as increased commonality with civil systems and improved interoperability with other communications agencies. This theme is dictated by DOD's evolutionary acquisition system and by the economic realities of constrained DCS budgets. The constant need for expanded services demands that the design approach retain flexibility to improve as opportunities permit, yet competition for monetary resources insists on greater cost efficiency. Thus, there will be a need for balance as well as for facilities that support the evolutionary systems. (182) B-1

The main reasons for changing the baseline facilities are (1) deficiencies in the quality and reliability of power, (2) energy inefficiency, (3) lack of facility standardization, and (4) possible vulnerability to sabotage and EMP effects. Energy use at the DCS sites will continue to escalate the total cost to DCS. Power system improvements and power-saving steps can reduce energy expenditures, leading to many benefits in availability and reliability. Changes in DCS communications equipment will permit real gains within the total communications complex. With the size of equipment and power consumption reduced, new approaches to facilities and facility support become possible. Areas other than power, such as environmental control and building size, can be demanding with respect to heating/cooling requirements. Also, spectronics and facilities equipment can be designed on a system basis to take advantage of individual system characteristics. (182) B-2

DCS facilities thus will evolve in different aspects during future development. Several trends will be evident in this transition, as summarized below.

Transmission Media

Programs are available to change much of the DCS transmission media to digital techniques using a mix of media nodes. Pulse code modulation will provide the initial digital transition. Submultiplexers are programmed to replace old voice-frequency carrier telegraph equipment, and these will combine low-speed data input into a composite higher bit stream suitable for interfacing with 64 kbps data. Other time-division multiplexers are also being developed to support the digital DCS; bulk encryption is being developed for wideband links. Initially, wideband circuits between CONUS and overseas gateway stations will be encrypted, followed by encryption of the more critical overseas trunks. Commercially leased bandwidth will be bulk-encrypted at Government-owned technical control gateway facilities.

Early conversion from analog to digital transmission is a primary planning objective for DCS links because digital systems offer improved security performance, lower O&M costs, and pacing factors due to commercial, tactical, and data processing trends. Most terrestrial systems will be converted to digital ones by FY92, leading to bulk encryption, unstaffed stations, fewer modems, and simple interfaces to circuit switches. High frequency (HF) systems will be improved using adaptive techniques and new modems for digital operation. Economics will determine the timing of commercial terrestrial systems being digitized, but the long-term trend is toward digital transmission.

Wartime stress threats provide strong motivation for improved DCS connectivity. Interconnects with tactical, allied, and commercial systems thus are being considered to counter wartime conditions. A Joint Military Tactical Satellite System (JMTSS) is being considered to interconnect tactical systems with the DCS and to extend the DCS in wartime. Satellite systems, commercial as well as the Defense Satellite Communication System (DSCS), will be improved. Commercial satellites will offer multiple spot-beam antennas, higher operating radio frequencies, on-board TDMA switching, small earth terminals, and demand access. DSCS will acquire adaptive controls, channelized transponders, multiple-beam antennas, on-board processing, and extra high frequencies (EHF). Commercial systems, with increased commercial competition, will also offer attractive prices and route diversity as alternatives to Government-owned systems. (182) B-3

Satellite Media

Earth terminals served by the DSCS will number more than 600 by 1986. Among these terminals are the heavy, fixed variety and several small, transportable systems that will serve the ground mobile forces and special users such as the Diplomatic Telecommunications Service and the White House Communications Agency.

DSCS III space platforms will be operational in the mid-80s and will feature six transponders per satellite, multibeam antennas, channelized transponders, and adaptive power control. Two of the transponders will have 40-watt traveling wave tube amplifiers and the other four will have 10-watt traveling wave tube amplifiers. Antijam capabilities will become available with the AN/USA-28 modem and a spread spectrum multiple access (SSMA) modem for GMF terminals. The Jam-Resistant Satellite Communications (JRSC) program will field AN/TSC-86 terminals (with AN/USC-28 modems) near worldwide military command and control systems (WWMCCS) users, canceling their dependence on gateway satellite terminals. Higher frequency transponders (in the EHF range) can be expected for DSCS in about 1990.

Leased satellite service for INTELSAT will connect the CONUS to Europe and to the Pacific; DOMSAT will provide satellite service within the Western Hemisphere (Alaska, Caribbean, Hawaii, CONUS). Leased satellite service will offer single- and multichannel, point-to-point, analog, and digital service and will be cost-competitive over distances greater than 1300 kilometers. (182) B-4

Terrestrial Media

Terrestrial transmission systems will be converted from analog to digital type when existing equipment requires replacement or when it is otherwise necessary to convert. Network time synchronization will be applied for digital control. Fiber optic cable will be used to replace wire cable in some local areas as requirements and cost benefits dictate. The Digital Radio and Multiplexing Acquisition (DRAMA) program will provide transmission rates to 26 Mbps and bulk encryption. In the 1980s, a low-speed, time-division multiplexer (LSTDM) will offer user-to-user digital communications in multiples of 32 kbps. Unstaffed repeater stations for transmission systems will become more numerous.

HF radio systems will be retained primarily for restoral and contingency use. Digital HF transmission is expected, possibly to 16 kbps per channel. Since there is no existing plan or program for DCS HF radio advancements, the model for future HF is existing HF installations such as Croughton (Air Force), Pirmasens (Army), and Naples (Navy). The far-term concept is to transform the DCS into a Defense Switched Network (DSN). The DSN will have integrated transmission, switching, and technical controls and will be decentralized (in contrast to the present system) for long-haul communications. The network, above the base and local levels, will treat a whole base and a high density/high population user locale as a terminal. Maximum use will be made of commercially leased services. Separate network facilities and identities for AUTOVON, AUTODIN, and AUTOSEVOCOM will not be possible. The only distinction between voice and data services will be found at the user's terminal. Other concepts that will drive equipment acquisitions are:

1. Digital wideband transmission facilities as more communications satellites are used.
2. Bulk encryption as digitization proceeds.
3. Automation of most media functions as minicomputers and microcomputers become integral components of transmission facilities.
4. Unstaffed facility O&M as automation proceeds.
5. Reduction in the number and size of the largest facilities as a distributed (nodeless) and automated system is implemented.

6. More automatic interconnect opportunities between single transmission media systems (U.S.-commercial-international), and between user terminals and multimedia gateway facilities. (182) B-5

Message and Circuit Switches

Within the DCS switched voice networks, the feasible union of AUTOSEVOCOM and AUTOVON services will be evident as AUTOVON becomes the primary carrier for secure voice services. The trend will first appear in the Secure Voice Improvement Program (SVIP), which will be the vehicle for introducing a secure voice terminal to replace AUTOVON four-wire stations. AUTOVON itself will evolve to exploit developments in commercial telephony. AUTOVON/AUTOSEVOCOM will primarily change to reflect dramatic improvements occurring in commercial digital circuit-switching technology.

Common-user record and data traffic needs for the near term will be met by the AUTODIN I message-switched network. However, by FY92, AUTODIN I will have been merged into the Integrated AUTODIN System (IAS). The IAS is being developed to define a DCS subsystem that satisfies the requirements of AUTODIN I users worldwide in the most cost-efficient way possible. The IAS must be flexible enough to allow increases in system capacity and the addition of new capabilities, should such changes be justified by developing requirements. It will ultimately be fully integrated and engineered on a terminal-to-terminal basis.

Although the near- and midterm DCS architectures provide for independent switching functions through a wide variety of DCS subsystems (AUTOVON, AUTOSEVOCOM, and AUTODIN I), the future DCS will be characterized by distribution of the switching function and integration of DCS subsystems. The capability to switch nonsecure voice currently is provided by AUTOVON, whereas AUTOSEVOCOM provides secure voice switching. Beginning in about 1985, these functions will be merged under the SVIP as described above. Similarly, the IAS is designed to combine the packet switching capabilities with the message data switching capabilities of AUTODIN I. The final integration of functions will occur during the transitional period between 1998 and 2005. The end result of the integration process will be a cost-effective DCS III network supporting distributed communications and a unified signaling structure. AUTOVON, AUTODIN, and AUTOSEVOCOM will no longer be separate DCS subsystems; instead, they will consist of terminal programs served by a distributed DCS III/DSN.

Other plans for the near future include thinning the AUTODIN I switch population, developing a common family of AUTODIN terminals, and completing deployment of the current generation of Automatic Message Processing Equipment (AMPE). AUTODIN I switches will be phased out, and new elements (i.e., Inter-Service/Agency [I-S/A] AMPEs and Centralized Service Facilities) will be fielded. A major objective of the midterm architecture is to preserve continuity of existing network services throughout the transition from old to new equipment. To facilitate this smooth transition, functions unique to AUTODIN I ASCs will be reallocated to new IAS elements; for example, I-S/A AMPEs will be enhanced to include the functions performed by near-term ASCs. The far term will see increased integration of the IAS with other DCS subsystems and continued evolution to an all-digital environment.

Another traffic switching program that could have major implications for the future DCS (overseas) is the European Telephone System (ETS). This system consists of 140 switching centers to be installed during 1983-86 (in Germany, Italy, and the BENELUX nations) to replace the current Direct Distance Dial Network and other common user telephone networks in Europe. The ETS could replace the few AUTOVON switches programmed for retention in DCS Europe. The ETS also could be used as a preprogrammed (logic) switching capability for a completely new communications system concept called the "Integrated Transmission, Switching, and Technical Control" (ITSTEC). (182) B-6

System and Technical Controls

The overall trends toward automation and digitization are also apparent in technical control. The technical control improvement program is to provide more effective ways to control the DCS, especially in a crisis environment. The approach is to improve recovery/reconstitution response time by reducing dependence on manual control procedures and in turn exploiting, when possible, proven operationally oriented automated and semiautomated processor-aided procedures.

Several developments in technology can improve DCS recovery/reconstitution response time. The most important development is incorporation of technology in the DCS switching and transmission subsystems to facilitate subsystem-level controls, thus enabling recovery, reconfiguration, and interoperability. An example is the DSCS, which is evolving with increasing flexibility to dynamically manage and reallocate satellite resources in response to traffic requirements and stress situations. Similar capability to dynamically reallocate terrestrial digital transmission resources is also feasible. A second development is the emergence of the tactical Communications System Control Element (CSCE). The CSCE will provide the communications and processing resources for exchanging and processing timely management and control information throughout the tactical echelons. This system control concept has potential application in the DCS.

The major improvements anticipated for control capabilities during FY83-92 will likely evolve from six major ongoing control programs:

1. Worldwide On-Line (WWOL) system upgrade.
2. DCS System Control Improvement Program.
3. DCS Technical Control Improvement Program (TCIP), both manual and automatic.
4. DCS Voice Orderwire Program.
5. DSCS Real-Time Adaptive Control (RTAC).
6. Establishment of a Network Control Center (NCC) in support of DCS. (182) B-9

Facilities

Facility designers and users will begin taking advantage of new technology aimed at their needs. The evolving DCS baseline will affect the needs for structure size, environmental control and power requirements, and proper grounding, bonding, and shielding.

The move to integrated circuitry by various elements of the DCS will have a profound effect on structures that house DCS elements. First, it will permit consolidation within buildings designed for retention. Although some modification within the structure will be necessary, parts of the building will be filled for other purposes, thereby lowering building maintenance costs. Functional consolidations will permit cross-utilization of manpower, reduce manpower-intensive communications-electronics (C-E) functions, and result in reduced annual DCS O&M costs. The move to smaller electronics will permit the use of smaller sites that are easier to secure and that have a reduced need for external utilities support. Although the next 10 years may see few new DCS sites, extensive modifications will occur at many existing sites. The need to acquire real estate is a major contributor to the utilization of present locations, since in many locales new land acquisition is nearly impossible. There will be a trend to standardize as facilities are built, modified, or leased. These standards will include concepts to increase the structure's flexibility in configuring or adapting to changing requirements. Consistent with efforts to improve the standards and flexibility of DCS structures will be efforts to improve the survivability protection against conventional warfare and EMP threats through the use of innovative construction concepts. These include using earthen covers or adapting standard buildings to DCS sites quickly. For the near- and midterm, the structure, other facilities, and equipment will be adapted and integrated more closely to reduce energy consumption, lower maintenance costs, and rely less on personnel.

As the DCS evolves, power systems that support the communications system will be improved to insure reliability in providing the quality of power required. The cost of commercial power is expected to continue rising, so that the evolving DCS baseline will move toward alternative power sources when possible. The need for back-up power will remain and the rotating engines that provide it will be in the system into the midterm. However, diesel generator use should decline as onsite power becomes more practical using photovoltaic solar panels. At some sites that require large amounts of power, the reliable long-life diesel motor generator may supply the primary power.

By the end of the midterm there will be few exceptions to a total d.c.-powered DCS. This will increase efficiency and reliability by reducing the number of components in the system. It will also improve the DCS' ability to use renewable power sources such as photovoltaic solar panels, wind-powered generators, thermoelectric generators, and other power sources for which the output is generally d.c.

Renewable energy sources may not be practical in all cases. For example, there may be long periods of no sun or wind when a nonrenewable source must carry the load. Since during wartime a particular fuel may not be available, emphasis will be placed on developing and placing in the field systems that can use several different fossil or synthetic-type fuels.

As new facilities are designed or modified there will be more specific adaptation of the power source to the power requirement. The use of integrated circuits will, in general, require less power as will ancillary components such as environmental controls. Also, the practice to oversize the power system to accommodate possible expansion will be discontinued. The net result by the 1990s will be a savings in total power cost, including costs for fuel, commercial power, maintenance, and personnel to operate and maintain the equipment.

The energy crisis and the trend toward use of lower power dissipation electronics using integrated circuits has made it possible to eliminate complicated environmental control systems. The improved electronics can operate at wide ranges of conditions, thereby reducing the need for a tightly controlled air supply and permitting use of outside air. With the environmental controls eased, significant energy savings can be realized.

Integrated circuits permit the use of innovative packaging or building design to assist in environmental control and to lessen demands for energy. An example is the grouping together of high heat dissipation components, eliminating the need to cool an entire area. Environmental controls traditionally have been part of the building but as the DCS evolves, that trend will fade. As the communications complex becomes smaller, the environmental control system can be adapted to the communications equipment. Portions of buildings can be blocked off to insure that only the critical components are subjected to a precise environment, not the entire structure. Providing a determined integration of the environmental control system with the electronics, power system, and building will permit a more efficient operating unit and reduce environmental control failures. (182) B-12

Many DCS sites have inadequate grounding systems or systems in need of repair; however, the need for more attention in this area is recognized to provide better performance and protection against lightning, EMP, and similar phenomena. Improvement is expected to occur naturally as sites are reconfigured with new electronics. There are plans to rework grounding fully on a system basis at every station targeted for major change in electronics during the next 10 years. (182) B-13

Summary

This introduction has summarized the effects of technological opportunities, planned and programmed DCS trends, and nontechnical/non-programmatic considerations 10 to 20 years into the future, including the DCS architectural concept ITSTEC with respect to the 1990s DCS requirement for facilities support. First, the waves of modern, complex, and sophisticated C-E equipment on the commercial market, such as powerful microprocessors spawned from large-scale integration (LSI) technology, offer more cost-effective use of switches, concentrators, and multiplexers within the DCS. The fringe benefits that generally accompany microelectronics are improved reliability of hardware, inherent modularity, and reductions in physical size and energy demands. In fact, some electronic switching systems in the Bell System now operate at such low power levels (less than 6 volts and at a few milliamperes) that conditioned power and shielding become stringent facility requirements. Microprocessor technology will be reflected in DCS C-E equipment and in facilities equipment over an extended period of time extending well beyond 1990. This is because the motivation to make basic changes to the DCS must come through very fundamental, strong reasons. To date, the motivation behind DCS assimilation of modern technology is not a need for technology, per se, to fix a broken system but, the need to find ways to provide existing communications at lower annual O&M costs.

Second, driven again by economics and by much activity in the commercial sector, there will be increased installation of satellite ground terminals associated directly with individual (community) access areas (e.g., single bases and large military populations such as those found in the Washington, DC, and Tidewater, VA, areas). A basic satellite architecture will emphasize direct interconnection between access areas and will deemphasize terrestrial connectivity and switching via rigid backbones that are manpower-intensive. Since military use of satellite communications requires the same measure of survivability and resistance to radio signal jamming as required of any other communications media, it is expected that, as an expedient, connectivity between access areas will be affected first through the switched public networks. This arrangement will continue until satellite communications are hardened enough to make the media viable in war time. In either a public or a military satellite network, without benefit of a Government-furnished backbone, a more unified strategic-tactical DOD switched communications system will evolve. A system like this will represent a second generation DCS that involves real-time dynamic allocation of wideband, digitized transmission channels through DCS switching and processing functions within or adjacent to access areas.

These functions have been defined within the ITSTEC conceptual architecture that could be implemented during 1984-94. The significance of the ITSTEC concept to this study of facilities requirements is that an entirely new, different DCS station is suggested that combines DCS functions which, to date, have generally been supported by separate structures, power plants, environmental controls, and G-B-S installations.

The third major condition influencing facilities requirements along new directions is the development of new perspectives concerning the DCS mission. These perspectives are again driven by economic imperatives to obtain the most utility from finite resources. Over the past 16 years, budgetary constraints have reduced the availability of Army and Air Force tactical communications in-theater assets. Consequently, there is now increased dependence on the in-theater DCS to support U.S. combat forces in the initial phases of any conflict overseas. However, the DCS was not originally designed to be a wartime system. Therefore, a major underlying thrust driving new DCS architectures is "design-for-war."

The DCS research and development strategy for "design-for-war" is to configure/harden certain DCS subsystems based on criticality of the DCS users' needs. This strategy was adopted because a composite DCS resistant to all threats is neither technically feasible nor economical. Therefore, improved DCS readiness will be achieved by developing countermeasures against specific threats in specific areas of the world. In Europe, the all-time threat to the DCS is sabotage; the overt hostilities threat is the collateral effect of conventional munitions delivered by aircraft. At the same time, there is a measured approach to DCS wartime readiness and an increasing concern with the annual DCS costs of providing day-to-day peacetime communications. Fossil fuel and manpower are the most inflationary of the annual recurring costs in MILDEP budgets. With a theoretical monetary lid on how much a peacetime DCS is allowed to cost, it has become necessary for DOD, DCA, and the services to find cheaper alternatives to fossil-fueled power and to find less manpower-intensive ways to support DCS O&M responsibilities. (182) B-57

4 Updating DCS Facility Information

The facility information contained in Volumes 1A, 1B, and 2 is intended to be updated every 2 years as requirements for DCS transmission, switch, and control facilities evolve. Three aspects of the DCS have been and will continue to be the basis of the need for dynamic, evolving DCS facilities:

1. The continuing development of communication transmission, switch, and control equipment--especially the expanded use of computer-automated devices to augment existing capabilities.
2. The refinement of alternative energy sources to be more cost-competitive and less vulnerable to existing commercial power with diesel generator standby back-up.
3. The development of improved security and survivability components that will enable existing DCS installations to become less vulnerable to sabotage and attack threats.

As the existing facility information in each edition of Volumes 1A, 1B, and 2 is used for specific projects that are constructed and operated, it is intended that facility evaluations be carried out to provide feedback to the documents. This feedback can be either additions to provide more comprehensive facility information or deletions to eliminate information that becomes outdated. Over time, the volumes can become handbooks of the best current information available.

5 Example Projects--Retrofits and New Construction Case Studies (Volume 3)

As part of the development of these facility documents dealing with the application of generic optimal DCS space information, several case study communication stations were designed to be constructed, implemented, and evaluated. These were done through the auspices of the MILDEPs responsible for DCS facilities. The reader is invited to carefully review the floor plan drawings and other section and elevation diagrams to understand the optimal capabilities and flexibilities of the design solutions. The reader is then referred to the generic design information for each space in Volumes 1A, 1B, and 2.

By using the examples presented in Volume 2, which have been derived from information on the various DCS facility types in Volumes 1A and 1B, the reader should be able to develop an optimal layout design for any communication station. Special conditions (survivability, security, etc.) that also must be considered when designing DCS facilities are referenced back to Volume 2. Therefore, the examples are intended to be studied to provide readers with an awareness of how the comprehensive generic facility information in Volumes 1A, 1B, and 2 can contribute to specific projects--they are not used as standard design solutions to be copied.

Of the examples, some are OCONUS new construction projects, some are OCONUS survivability retrofits at existing DCS sites, and the remaining ones are retrofits that improve operational conditions in transmission, switch, or control spaces of existing DCS buildings.

SWITCHING FACILITY MODULES

Digital circuit switching

Although current circuit switching networks (both U.S. and foreign) are primarily analog types, the shift toward digital circuit switching has already begun. Two concepts are involved: the use of digital logic within the switching system and the switching of digital signals.

The digital trend appears to be worldwide in scope; many countries, both advanced and developing, have already made commitments to use digital switching equipment or are seriously considering implementation of such technology. In addition, digital technology is penetrating all levels of the switching hierarchy. Digital switching will cut across all levels, from the Private Branch Exchange (PBX) and Private (Automatic) Branch Exchange (PABX) markets to the local, toll, and tandem networks.

Several advantages have resulted from implementing digital technology within the switching system. The extensive use of large-scale integration (LSI) within the switch has brought reductions in system size, weight, and power consumption. In addition, the introduction of digital switching and transmission has simultaneously reduced the number of analog-to-digital conversions needed along the transmission path. This not only has lowered equipment costs, but has improved reliability and signal quality as well. The use of digital techniques also has increased the flexibility in networking and has expanded end-use features.

Another advantage of digital switching is its potential for cost reduction both on first-cost and recurring-cost bases. The smaller size, reduced installation costs, and high capacity lower initial costs, while the inherent reliability of digital circuitry and extensive use of modular, plug-in circuit cards help reduce the costs associated with operation and maintenance (O&M). Moreover, while the price of digital switching is becoming lower, analog switching costs are beginning to rise. Compounding this effect will be that, as investment in switching equipment shifts from analog to digital, simple economies of scale in production and training will continue to drive down the cost of digital switching and increase the cost of analog switching.

Decreasing size of switching equipment (182) B-31

A major objective in designing current switching systems has been to reduce the size of equipment involved. A comparison of old, current, and planned equipment demonstrates that this goal has been met; new systems allow expansions in capacity without requiring increased facility size.

The introduction of electronic switching systems has provided a three or four to one reduction in size over the electromechanical systems they replace. Successive generations of a given switching system (whether electromechanical or electronic) tend to follow this trend, resulting in overall size reduction at a systems level.

The impact of these changes is that over 2 million words of call storage and 1.5 million words of program storage can now be contained in the same frame space which, with the earlier ferrite core memory, could hold only 256K words. The call and program storages in a newly equipped office occupy only 20 percent of the total processor area.

Changes in the switching network itself also have effected a reduction in size. Initial time multiplexed switch and time slot interchange units, based on small-scale integrated circuit (IC) chips, have been redesigned to include medium-scale IC chips. This has allowed a substantial increase in circuit packaging density. (182) B-33

Decreasing power requirements

With the decrease in switching system size has been a steady decline in power requirements. The almost 70 percent decrease since 1976 has been achieved through extensive use of integrated circuitry.

Increasing capacity of circuit switching systems

A third change in systems design has been the increasing capacity of circuit switching systems. Improvements in system software as well as the introduction of new hardware have triggered this growth.

The clearest example of these larger capacity systems is the Bell Systems' No. 1 ESS. Although the introduction of new hardware units such as the signal processor (1968), the service link network (1970), and the 1A processor (1976) increased this switching system's efficiency and capacity, the capacity growth often resulted solely from improvements and refinements to the stored program that controls the system. (182) B-35

Increasing modularity of switching hardware and software

The flexibility to incorporate new advances into an existing system has become essential. Therefore, in almost all switching systems studied, a major objective is to design a system that can evolve over its lifetime. In all cases, the use of modular software and hardware is stressed to achieve this flexibility. However, despite the advantages of using standardized hardware and software modules, one disadvantage is possible: the desire to remain completely compatible with an older system may postpone the implementation of new, incompatible technologies.

Extensive use of stored program control also allows much of the flexibility and modularity needed in an evolving network. Because system control is implemented in software, new features and capabilities can be incorporated simply by changing programmed codes. This task is simpler than actually rewiring and reconfiguring each piece of hardware.

Developments in switching system operations and maintenance

The increasing capacity and complexity of today's switching systems are placing great demands on the organizations associated with the systems' maintenance, operation, and administration. In addition, rising labor costs are forcing these organizations to devise more efficient and less personnel-intensive methods to complete their missions. Several factors have made these improvements possible. For example, use of modular, plug-in circuit cards has greatly simplified the maintenance process; the extensive automation made possible by advances in LSI and minicomputer technology has increased the efficiency of fault diagnosis and isolation procedures as well as system administrative functions. This increased automation and the inherent reliability of state-of-the-art switching systems have allowed many local offices to operate unattended on a day-to-day basis. Therefore, a trend toward centralized O&M facilities serving many exchanges in one vicinity has emerged as the most cost-effective solution to the O&M problem. The result of these improvements has been that, in general, O&M costs for electronic switching systems have declined approximately 30 percent compared to those for electromechanical systems.

Centralized O&M potentially allows more efficient use of personnel and resources than with a decentralized method. A major advantage of the centralized maintenance philosophy is that the continuity and variety of work provided facilitates on-the-job training of personnel. Because workers are exposed to a much wider variety of equipment and problems, it is easier for them to attain an advanced skill level. Additionally, the more efficient use of highly skilled personnel resulting from centralization allows a decrease in the ratio of highly skilled to nonspecialized labor.

Another major advantage of centralization is the reduced inventory of spare parts required. The provision of a single central buffer stock at the O&M facility with only minimum stocks at the individual exchanges will reduce the capital investment required for spare parts and also will allow improved stock control. The potential disadvantage is in the longer mean time required for repair once a fault has been isolated.

Defense Switch Network (DSN)

Integrated voice and data switching (182) B-138

Current communications systems have separate networks for voice and data; however, it appears that future systems will have integrated networks that can provide multimode switched services for voice, data, facsimile, and video. The duplication of both switching and transmission facilities necessary with separate voice and data networks is simply too inefficient and will not provide the flexibility demanded by future users.

Several factors will make it both possible and necessary to integrate voice and data systems. First, as digital technology spreads to voice communications, it will become possible to combine voice and data in a common network. The trend toward an integrated system also will be driven by changing customer demands; the user who previously required only voice service soon may need various types of data communications (e.g., electronic mail) as well. The increasing reliance on data communications by users formerly involved only in voice communications will make integrated networks a natural solution.

Several approaches have been offered for implementing an integrated voice and data network. For example, both pure packet switching and time-division circuit switching have been considered, but the most flexible approach appears to be based on hybrid combinations of circuit and packet techniques. Pure packet switching poses the problem of delay for voice applications whereas circuit switching alone does not provide the most efficient use of capacity for data applications. In contrast, hybrid techniques, particularly when implemented using a flexible allocation method, allow the transmission capacity to be shared between circuit-switched voice and packet-switched data traffic. This sharing would require less overall capacity than would separate circuit and packet networks.

A survey of the literature reveals that an "Integrated Services Digital Network" is being studied, but such an integrated multipurpose network probably will not be implemented on a large scale until post-1985.

Integrated circuit technology (182) B-13

For the past 20 years, integrated circuits have been increasing in complexity and capability. At present, it is possible to put about 100,000 gates on a single chip. This density is likely to at least double and perhaps increase by a factor of five or more. At the same time, the speed of these devices will increase by a factor of about 50 or more (as indicated by the Propagation Delay figures) and the power consumption (per gate) will drop by a factor of five or more. Furthermore, the new technologies will operate on lower power supply voltages than present N-channel metal oxide semiconductor (NMOS) and complementary metal oxide semiconductor (CMOS) systems.

These trends make computerized network switches even more attractive than previously. In the area of the processor itself, faster speeds will increase throughput over current microprocessors, enabling one processor to do more. In some cases, this will eliminate the need for elaborate multiprocessor architectures to increase system throughput, reducing the number of components required and, with this, the power consumption, space requirements, and waste heat generated.

Besides influencing the size of power supply required, power dissipation also will affect the size of environmental conditioning units needed. Most power now dissipated by microprocessors and memory devices ultimately appears as heat. Future systems will have a "bubble memory" of a given size that will generate about one-sixth the heat of a semiconductor memory, reducing the size or possibly even eliminating altogether the need for cooling equipment (e.g., fans, water-cooling, air-conditioning).

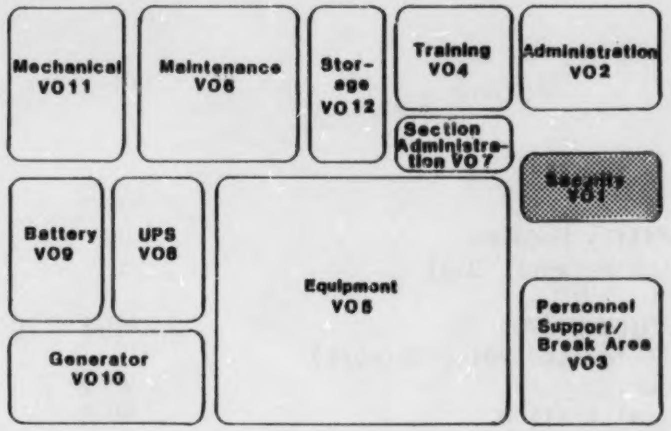
The main effect of these trends will be to reduce or eliminate the need for maintenance personnel onsite. Besides the inherent high reliability, it is possible to include in the system self-diagnosing and self-correcting features by using redundant modules. Another alternative is remote testing through data communications channels; this arrangement would allow a small maintenance staff to monitor and diagnose faults from a central test facility that could be located virtually anywhere in the world. Repairs also could be effected using remotely controlled switchover to standby modules. (182) B-19

Switching Facility Modules
(Defense Switch Network--DSN)

Voice - AUTOVON (VO) (Automated Voice Network) VO-1
VO1 Security VO-2
VO2 Administration VO-8
VO3 Personnel Support/Break Area VO-12
VO4 Training VO-16
VO5 Equipment VO-22
VO6 Maintenance VO-30
VO7 Section Administration VO-34
VO8 UPS (Uninterrupted Power Source) VO-38
VO9 Battery VO-44
VO10 Generator VO-50
VO11 Mechanical VO-56
VO12 Storage VO-60
VO13 Standardized Modules VO-64

Voice-AUTOVON
[VO]

SECURITY VO1



function

This component provides overview for verifying visitors before they enter the facility. The Intrusion Detection System and fire alarm equipment are monitored in this area. Also, when required, facility personnel weapons are stored and distributed here.

policy/sop

1. The building site must withstand intrusion by individuals or groups intending to compromise the security of the information transmitted and received at DCS facilities.

2. The overall approach to providing security at DCS sites consists of five elements: (1) intrusion deterrence, (2) intrusion detection, (3) alarm assessment, (4) component and physical plant hardening, and (5) security or response force personnel. Intrusion deterrence is intended to produce a psychological state of mind in a potential intruder that intrusion will result in unacceptable counteraction. Intrusion detection is intended to provide an alarm to the operating activity or security personnel that an unauthorized intrusion has occurred at a DCS site. Alarm assessment is intended to verify that an intrusion alarm was activated by a threat against the DCS site. Component hardening of the physical security system is intended to delay the damages or to limit the amount of damage that can be inflicted on a site. Security force is intended to delay, stop, or mitigate the actions of an intruder. Every DCS site security program shall be prepared to include these five elements. (9) 4.3.3.1

3. The security alarm system should also be wired into either Tech control or the operation area spaces. These spaces will be staffed 24 hours per day, and the same personnel could monitor the security system. The receiving/administrative spaces usually are staffed only 8 hours per day during the week.

4. Most OCONUS sites have local national (LN) guards that maintain security at the perimeter fence during daytime hours. At night this function reverts to site shift communication personnel. All entry alarms should be "remoted" to locations within the operations building similar to that of closed-circuit television (CCTV) monitors. This will preclude assigning critical personnel to security duties. All alarm systems should be "remotable" to the operations console.

issues and assumptions

1. Full-time lighting versus "on-demand" lighting

Continuous lighting (stationary luminaires) is the most common security lighting system. It consists of a series of fixed luminaires arranged to flood a given area continuously with overlapping light cones during the hours of darkness. Standby lighting differs from continuous lighting in that standby lighting is intended to create an impression of activity. The luminaires are not lighted continuously, but are either automatically or manually turned on at random or when suspicious activity is detected or suspected by the security force or the intrusion detection system (IDS). This technique may offer great deterrent value as well as economy in power consumption. (37) 13.1-120

2. Automatic actuation of security lighting versus manual lighting

A deterrent lighting system can be developed to turn lights on at random or, rather than randomly activating the luminaires, an IDS sensor can be used to turn on the lights when an intruder is detected. This type of active lighting system provides maximum deterrent value at a low duty cycle. (37) 13.1-124 Automatic actuation of lights for normal operations seems most advantageous; however, manual override should be provided for control.

activities

1. Viewing personnel entering the complex.
2. Monitoring IDS equipment.
3. Operating facility physical security program.
4. Distributing and storing personnel weapons.

personnel

1. One.

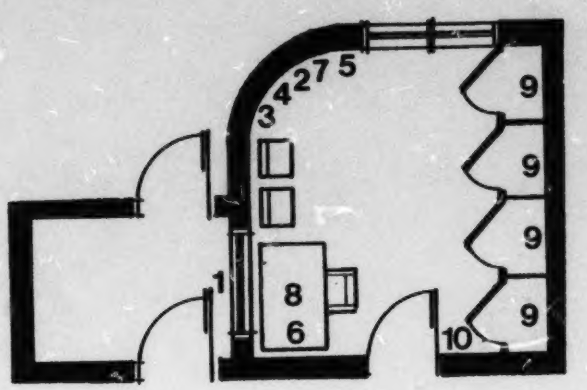
equipment*

1. Pass window for identification.
2. Annunciator panel (sensor information).
3. Closed-circuit TV.
4. Gate control for perimeter security fencing.
5. Exterior lighting control.
6. Communication link to host agency.
7. Alarm for intrusion detection to host agency security office.
8. Desk (or counter unit) with chair.
9. Racks for personnel weapons. Weapon distribution is through a door with a daygate for passing through.
10. Humidifier.
11. Intercom speaker.

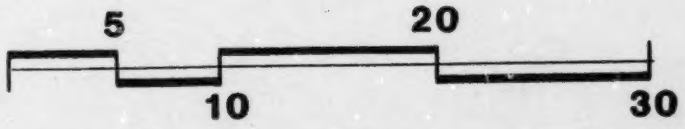
* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate IDS equipment and personnel associated with security component.	1. Provide space for one person who verifies and monitors the facility's security. This area varies with size of facility, but typically is 200 to 300 square feet.	
2. Visual verification of entering personnel.	2. Provide a pass window.	
3. Communication and electronic monitoring lines.	3. Coordinate IDS components into a centralized module. Provide an annunciator panel with telephone and intercom link-ups. The operation room console should have remote alarms along with a CCTV monitor.	
4. Resistance against penetration from the outside and for the armory.	4. Windows should be glazed and hardened to prevent penetration (bullet-proof glass). Windows also should be designed for full visibility over approaches to the point of entry.	4. See Vol 2, SB7, Security (Zone 3), for more information.
5. Interior finishes suitable for durability, maintenance, and room function.	5. Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	5. See also Vol 2, SB2, Interior Construction and Finishes.
6. Acoustical isolation and attenuation for a nondisruptive environment.	6. The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	
7. Adequate lighting to review entering personnel and monitoring equipment.	7. Lighting shall be specially engineered. Low levels of lighting may be required to permit observation of luminous panels without reflected glare or undesirable contrasts in brightness. Separately controlled luminaires shall be provided for normally lighted operations and clean-up; this lighting should have an ambient level of 70 footcandles using fluorescent fixtures.	7. For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical Lighting.
8. Thermal regulation and other comfort features for the occupant.	8. Maintain temperature at 68°F (heating) or 78°F (cooling) with a 5 cubic feet per minute per person outside air ventilation rate. A dehumidifier may be required in the armory. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	8. See also Vol 2, SB2, Communication Station Buildings--Mechanical.
9. Electrical power.	9. Provide 120/128 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and for every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	9. See also Vol 2, SB2, Communication Station Buildings--Electrical.

guidance



11-- speaker in ceiling



guidance

1. Location

The minimum area is determined from IDS monitoring equipment physical dimensions.

Direct access to facility entrance is required.

This area must have no direct access to C-E equipment.

This component can be combined with the administration function in the small module package.

2. Verification

Orient windows to allow visual security of arriving personnel. In some circumstances, it works well to use mirrors to show the total front face of the building before the door is opened. This also prevents the security officer from confronting unexpected hostile action when leaving.

3. Monitoring

Three shifts in a 24-hour period are assigned for these activities if the personnel are available. At some smaller facilities, the security alarm and detection devices should also be wired into the operations, operations administration, or control monitoring space so that operation shift personnel can monitor the security system when the security space is not staffed.

Alarm system--Provide a wall-mounted alarm terminal panel in the security room. The following alarms will terminate there:

- Smoke/fire detection
- Intrusion detection of all doors and barred openings.

The termination board or its associated housing should have all alarm terminations identified clearly with permanent marking or labels. This allows future extensions of these connections to a control and fault alarm system. The alarm sensors should incorporate only dry contacts (no voltages) and should use two conductor shielded cables in the circuit runs (or in conduit) to the consolidated terminal panel noted above.

Intrusion detection system--The IDS should conform to Corps of Engineers Guide Specification CE 304.01. Provide magnetic intrusion alarm switches on all exterior doors and openings greater than 7.6 feet at the perimeter into the building. Terminate all circuits in the wall-mounted alarm panel. The door alarm is to sound then the door moves 1/2 inch toward an open direction.

guidance

The various approaches to an alarm display problem offer a wide range of capabilities, but also present several distinct disadvantages. In selecting an alarm display system for a specific installation, it is essential that the features and capabilities required for the intended application be well understood. In particular, there is no one "best" system for transmission and display of security information. Rather, a system should be selected to meet the needs of the specific installation. It should also be noted that many systems may provide more capability than is needed or desired and that paying for unused features would tend to increase the system's cost. See Vol 2, SB7, Security Systems, for more information.

4. Primary entrance door

The primary personnel entrance door should be secured with a jimmy-proof, deadbolt extension operated by a combination lock in conformance with UL Standard 768 and Military Specification MIL-L-15596. The primary entrance door should also be equipped with panic bolts and a rim with a box mullion in conformance with Federal Specification FF-H-106. The panic bolts should be UL-approved. If required for routine access control, an electrically controlled latch mechanism is authorized for installation. RF emissions should meet the requirements of MIL-STD-461 of Class II-A equipment when applicable. (5) 3-5-9

The personnel entry doors should be the steel, single-swing type with a steel frame. Another option is a door constructed of hollow metal with a 1/8-inch steel plate face.

Personnel entry doors should also be equipped with a "peephole" wide angle lens. Doors should have an inside plate to cover the peephole when it is not in use.

Hinges on both the exterior personnel and equipment doors must be welded to prevent removal of hinge pins if pivots and pins are on the outside.

7. Lighting design

To reduce glare at video digital terminals (VDTs), use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values.

The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On tall ceilings, the cell depth must be greater; this may dictate a larger cell size.

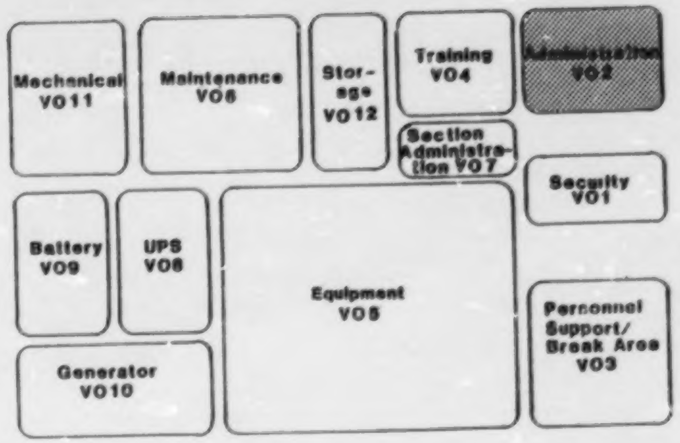
Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

guidance

guidance

guidance

ADMINISTRATION VO2


Mechanical VO11
Maintenance VO6
Stor-age VO12
Training VO4
Administration VO2
Section Administration VO7
Security VO1
Battery VO9
UPS VO8
Equipment VO5
Personnel Support/ Break Area VO3
Generator VO10

function

To establish and maintain station administrative processing of personnel records; to implement written and verbal SOP directives from chain of command orders, host agency regulations and DCA policy for DCS; and to provide a buffer and transition space between exterior and secure interior spaces.

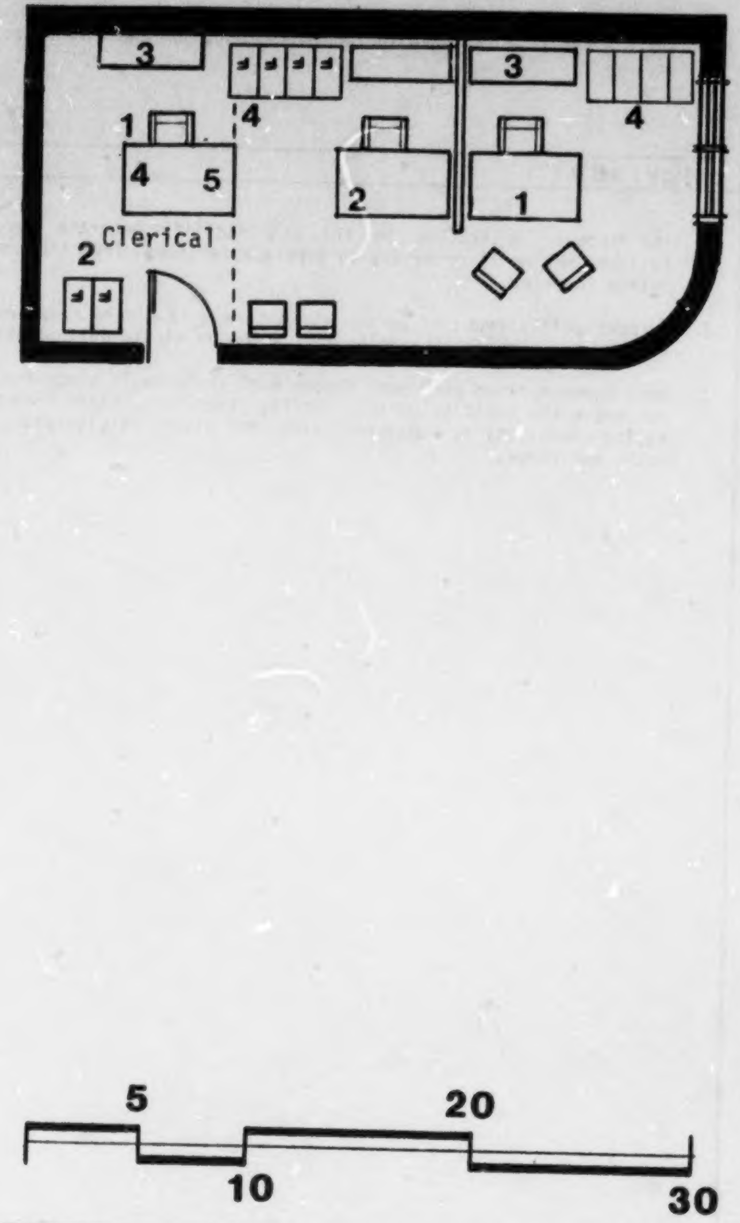
policy/sop

issues and assumptions	**activities**	**personnel**	**equipment** *
	Officer-in-charge (OIC) 1. Distributing directives, orders, and policy statements, both written and verbal, to shift supervisors. 2. Initiating evaluation of equipment capabilities. 3. Developing personnel training plans and equipment evaluations.	1. Site chief or OIC. 2. NCOIC and chief-in-charge.	1. Site chief workstation: • Desk/chair (enclosed) • Two side chairs • Credenza. 2. One NCOIC workstation : Desk/chair in open area (or with dividers). 3. Bookshelves--20 linear feet. 4. Nine files with five drawers each.
	Clerical 1. Typing, reception, and coordination of command/control process for the noncommissioned officer in charge (NCOIC). 2. Filing/posting of operations and personnel documents. 3. Providing courier service for paperwork.	1. One E-2 clerk (two at some installations).	1. Clerk workstation: Desk/chair (open area). 2. Two files with five drawers each. 3. Bookshelves--45 linear feet. 4. Typewriter(s)/word processor(s). 5. Operational voice intercom control.

* See "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the administrative function.	**1.** Provide administrative space for supervisory personnel. This area varies with the number of assigned personnel, but is typically 400 to 500 square feet.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Carpet. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	**3.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**3.** See reference 201, page 3-4, Table 3-2.
4. Adequate lighting.	**4.** Provide 80 footcandles for task lighting at work surfaces with 40 footcandles for the ambient level. Surface reflectances should be: • Ceilings--80 to 90 percent • Walls--40 to 60 percent • Floor--20 to 40 percent.	**4.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for the occupant.	**5.** Maintain temperature at 68°F (heating), 78°F (cooling), with 5 cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	
6. Electrical power.	**6.** Provide 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppresion--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunicator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location

Windows to the outside are recommended for CONUS facilities on secure sites, such as military installations. OCONUS facilities usually should have a minimum of windows to limit opportunities for forced entry.

Activity subspaces

- Enclosed offices
- Workstations
- Filing area
- Reception.

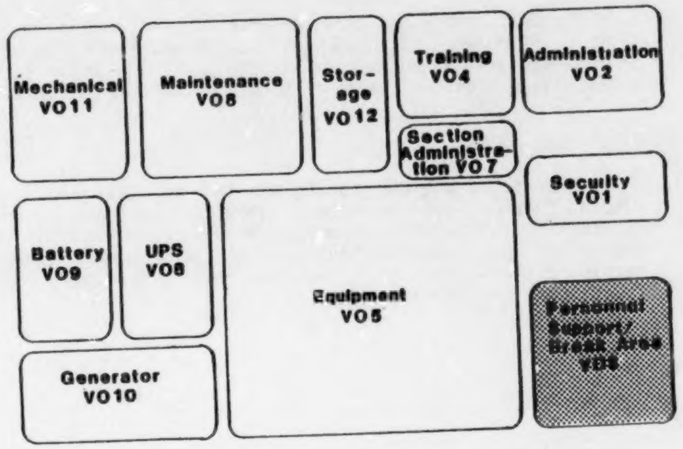
3. Acoustical and visual privacy

Divider partitions between workstations should be 60 inches high (± 4 inches) to provide visual privacy while occupants are seated--and yet should not be confining. Circulation paths around workstations should minimize disturbances to other workstations.

6. Electrical power

Workstation divider partitions can be tackboard surfaces to display maps, job examples, service equipment, and other information. Floor-to-ceiling poles are recommended to distribute electrical and communication lines to workstation modules. This eliminates floor wires at circulation paths and allows future module modifications at minimal cost.

PERSONNEL SUPPORT/BREAK AREA VO3


Mechanical VO11
Maintenance VO6
Stor- age VO12
Training VO4
Administration VO2
Section Administra- tion VO7
Security VO1
Battery VO9
UPS VO8
Equipment VO5
Personnel Support/ Break Area VO3
Generator VO10

function

This component creates a change of environment for on-duty personnel to provide a break from the hard-surface equipment room and work areas.

policy/sop

1. The intense activities in the DCS facility generate personnel fatigue, making it necessary to separate personnel from the communication function.
2. Current policy requires personnel to have a 15-minute break every 3 to 4 hours. Typical schedules also allow 30-minute meal breaks.
3. Most communication personnel "brown bag" their meals since they cannot leave the facility duri[illegible] shift. Therefore, basic food preparation capability is required: sink, hot plate, refrigerator, cabinets, and range.

issues and assumptions

activities

1. Relaxing.
2. Reading.
3. Eating.
4. Storing food.
5. Preparing food.
6. Storing personal items such as coats and books.

personnel

1. Two to eight at once.

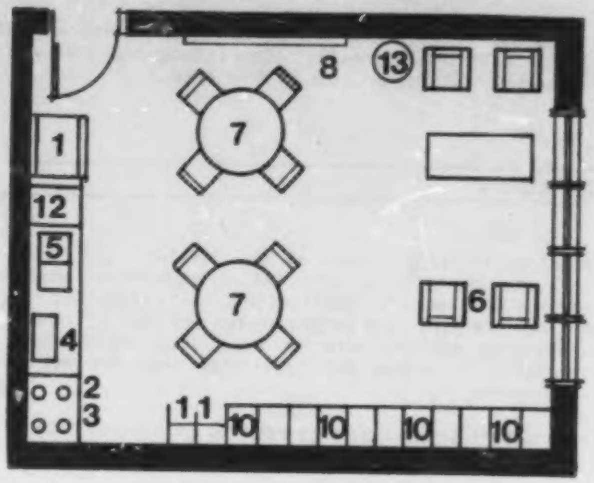
equipment*

1. Refrigerator.
2. Stove.
3. Range and range hood.
4. 20 x 30 inch sink in countertop which is a 6-foot minimum with cabinets above.
5. Coffee machine.
6. Chairs.
7. Table with chairs for eight.
8. Bulletin boards.
9. Intercom speaker.
10. Storage lockers for each person. (Not required for personnel who have private offices.)
11. Coat rack.
12. Microwave oven (if communication equipment is not affected).
13. Trash receptacles.

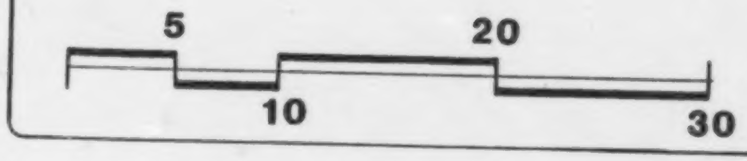
* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the personnel support/break area.	**1.** Provide approximately 500 square feet of space for equipment and furniture to accommodate up to 15 personnel.	
2. Visual separation from the communications equipment.	**2.** Provide visual separation that also allows viewing of the operations area when desired. Supply comfortable furniture and carpeting (earth tones are recommended).	
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Vinyl asbestos tile and area carpeting. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation for a nondisruptive environment.	**4.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**4.** See reference 201, page 3-4, Table 3-2.
5. Lighting suitable for reading (task and ambient).	**5.** Use 20 to 30 footcandles for ambient lighting and 100 footcandles for task lighting.	
6. Thermal comfort.	**6.** Control temperature for 68°F (heating) and 78°F (cooling) with a 5-cubic feet per minute per person outside air ventilation rate.	**6.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Provide 120/208 electrical service. 120-volt outlets should be installed for every 10 linear feet of wall. Counter height outlets are required for a coffee maker, mixer, microwave oven (when permitted), and other appliances.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**8.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety for more information.

guidance



9 -- speaker in ceiling



guidance

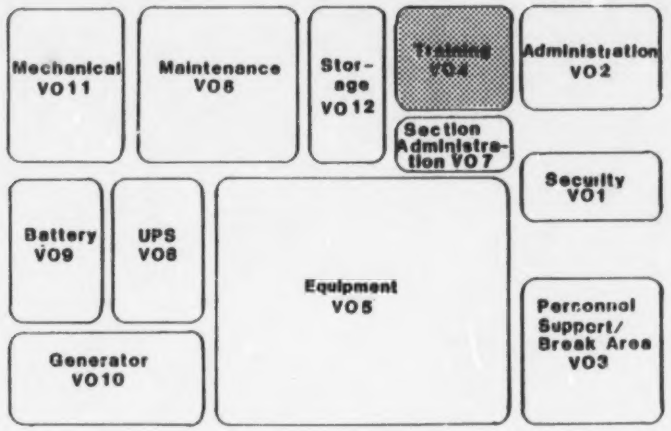
1. Location

The personnel space should be directly adjacent to the operations room, but isolated acoustically (absorptive walls) and visually (a curtain hung at the window).

3. Visual comfort

The color contrast, textures, and designs of the wall, ceiling, and floor surfaces should minimize glare for a comfortable environment.

TRAINING VO4


Mechanical VO11
Maintenance VO6
Storage VO12
Training VO4
Administration VO2
Section Administration VO7
Security VO1
Battery VO9
UPS VO8
Equipment VO5
Personnel Support/ Break Area VO3
Generator VO10

function

This component is for enhancing personnel abilities and effectiveness, both technically and personally. Development and implementation of the station master training program is done here.

policy/sop

1. Technical training occurs at two levels: (1) hands-on training, i.e., working directly with the communications equipment, and (2) learning from manuals, publications, and audiovisual equipment. The physical training also occurs at two levels: (1) interior individual exercise and (2) exterior small-group recreational activities, especially at remote DCS facilities that are not on a military installation.

2. Current policy requires personnel to be allowed time to train technically while on-duty at the facility.

3. Training usually is done during the times that the communication activity is at its lowest level.

4. Some communications personnel are engaged in a Career Development Course (CDC); thus, a training area is required. The Air Force counterpart is the Quick Training Package (QTP).

5. Training usually is conducted by the shift supervisor or a lead NCO/CO who is also on-duty.

6. In fire/life/safety training, safety implies the absence and/or control of conditions that can cause personal injury, death, damage to, or loss of equipment or property. Within the system, safety is concerned with the elimination or control of factors affecting the safe and efficient operation of personnel, equipment, and facilities organized to attain a common goal. The objective of safety training therefore is to insure maximum freedom from inadvertent and possibly destructive mishaps resulting from facility equipment, procedural, or personnel deficiencies during all phases of system operation. (70) 15-30

issues and assumptions

1. Three-shift versus four-shift impact on training time available

Most facilities operate on a three-shift basis:

Day shift	8 a.m.	to	4 p.m.
Swing shift	4 p.m.	to	Midnight
Midshift	Midnight	to	8 a.m.

By having personnel assigned to four shifts instead of three, one group could be a "training shift" that would be on duty during the day shift; thus, the peak activity period would have double the personnel available if required, plus give trainees the best opportunity to interact with facility functions.

The four-shift concept, however, assumes one or both of the following:

- More persons will be assigned to the site
- Staffing for the three operating shifts can be reduced.

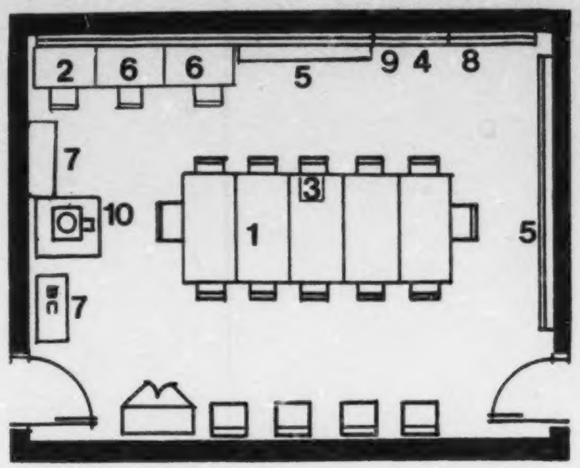
activities	personnel	equipment *
Technical training 1. Observing and evaluating personnel records; conducting personnel interviews to determine training requirements. 2. Developing overall master training plan and presenting special MOS training module program for a specific focus. 3. Studying manuals and other publications. 4. Watching video cassettes, 16-millimeter movies, and slides. 5. Instructing in fire/life/mission safety.	Instructors 1. Commander. 2. NCOIC. 3. Civilian technicians (not an office area for personnel).	Classroom/conference room 1. Table and seating for 12. 2. TV monitor/CRT terminal. 3. Viewgraph projection. 4. Charts and display panels. 5. Audiovisual projection and screens. 6. TEC library monitors. 7. Library of written instructional materials--20 linear feet. 8. Chalkboard. 9. Tackboard for training and information bulletins. 10. Audiovisual equipment storage cabinet. 11. Intercom speaker.
Physical training 1. Involves mandatory military training requirements for physical fitness, weapons qualifications, and CBR training.		Fitness area 1. Exercise equipment: 8 by 4 foot mat, weight set, and exercycle. 2. Exterior area for volleyball and half-court basketball. 3. Athletic and recreational items; balls, bats, horseshoes, etc. 4. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
Technical training		
1. Enough space for small groups (up to 20 people) that meet for small training seminars. Space for reading and studying manuals and other publications associated with the training function.	**1.** Provide 25 square feet of space per person. Equipment layout and storage require additional square footage.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation from the high noise level generated in the operations area.	**3.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**3.** See reference 201, page 3-4, Table 3-2.
4. Flexible lighting.	**4.** Provide adjustable lighting, depending on varied uses. • 20 to 80 footcandles at each work surface. • 10 footcandles at rear of room during audiovisual projection. Surface reflectances should be: • Ceiling: 80 to 90 percent • Walls: 40 to 60 percent • Floor: 20 to 40 percent.	**4.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for occupants.	**5.** Regulate temperature at 68°F (heating), 78°F (cooling) with 5 cubic feet per minute per person outside air ventilation rate. Seating should be adjustable to provide maximal body support comfort for many different sizes.	**5.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
6. Electrical power.	**6.** Provide 120/208 electrical service. Provide 120-volt outlets--one receptacle for every 10 linear feet of wall. Specific equipment outlets depend on the room layout.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

requirements	criteria	commentary
Physical training		
1. Enough space to allow each person to perform physical exercises and workouts.	1. Minimal area of approximately 150 square feet (10 by 15 feet).	

guidance



11-- speaker in ceiling

guidance

1. Location

Since most technical training involves hands-on experience with the communications equipment, the training room should be adjacent to the operations space and should have a view into the operations space if possible.

4. Lighting design

Classroom lighting immediately in front of a lecture platform can be controlled from a point convenient to the speaker's platform and also at the entrance. Lighting can be controlled by motor-operated dimmers from the platform and the main entrance to facilitate use of audiovisual aids. Lighting can also be controlled from those points by switches. Minimum lighting shall be provided so that notes can be taken during the use of visual aids.

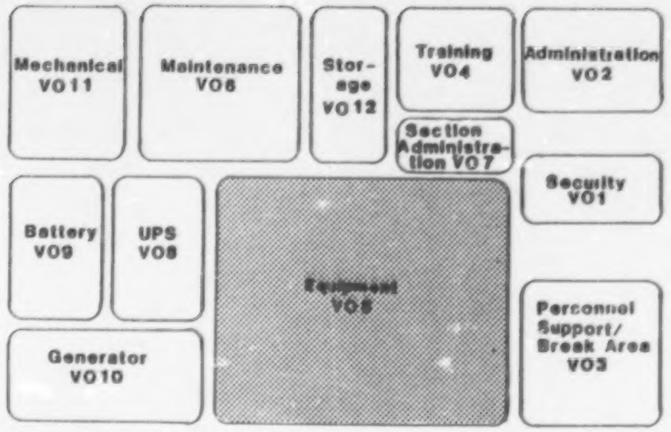
1. Physical training

See "storage" for interior physical training area guidance drawing.

guidance

guidance

EQUIPMENT VO5



function

To allow space for personnel to operate, maintain, monitor, and repair communication equipment optimally.

policy/sop

1. Equipment and its layout should be standardized as much as possible among facilities comprising a communications system. In determining the layout for situations in which unencrypted signals bearing classified information are present or processed, the specialized installation guidance in MIL-HDBK-232(C) must be consulted. Another major consideration should be necessary access for installation, maintenance, and operation. This would include allowance for adequate space between equipment rows to open cabinet doors or slide out modules for maintenance. (2) 5-20

2. Other equipment layout considerations include minimizing interbay cabling runs, providing for future expansion, and providing easy access for maintenance and operational convenience. Sometimes the electromagnetic incompatibility of various types of equipment or inadequate ventilation for personnel and equipment can be problems. Equipment of the same type or with similar functions usually is grouped together except when impractical due to a station's size and specific requirements.

3. Equipment should be grounded properly according to function and interoperation. Care should be taken in arranging meters, test equipment, jackfields, indicating lights, etc., to insure they are placed at approximately eye level, thus allowing more rapid, convenient use. Equipment should not be mounted at the bottom of a bay if it could be damaged easily or if its size and shape would interfere with power boxes or other hardware at the cabinet or rack base. (2) 5-21

4. This station's operational plan must be studied when placing each component or rack assembly to determine the communication circuit requirements. In small stations, it is recommended that the equipment be aligned in a row along one or, if need be, both sides of a building with enough space between to accommodate a normal floor traffic pattern. However, this type of layout generally will not be suitable in stations that have large amounts of equipment. In the large station, the most practical layout usually is one in which the equipment is aligned in bays across the width of the room, with enough space between bays to permit free access to each rack assembly. (2) 5-22

issues and assumptions

1. Automated recordkeeping

CRTs with hardline printers can eliminate time-consuming paperwork by storing all circuit history files on disks. This will allow troubleshooting activities to be done much more rapidly in-house.

2. Electromagnetic compatibility (2) 5-43

Electromagnetic compatibility (EMC) is a complex subject with specialists often needed to perform an EMC study to insure that the equipment or equipment layout produces no interference or radiation hazard.

New DOD regulations control permissible levels of electromagnetic pollution of the frequency spectrum due to the concern for environmental protection. Radiation also is being regulated through concern for occupational safety. Engineering agencies hired for DOD work must understand the legal and regulatory aspects of EMC and radiation hazard to meet these requirements.

Military specifications on EMC, such as MIL-STD 461, 462, and 463 are intended to control and achieve an acceptable figure of merit or quality in the development of new communications equipment. They do not eliminate the need for EMC engineering in facility design. In addition to equipment quality, frequency selection, nearness to other facilities and, to some extent, the facility design itself are variables in the interference generation problem. (2) 5-43

3. Determining the correct shielding procedure

A comprehensive approach to shielding equipment from radio frequency interference (RFI) or TEMPEST involves (a) a building layout to optimize inherent facility shielding conditions, (b) appropriate location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components.

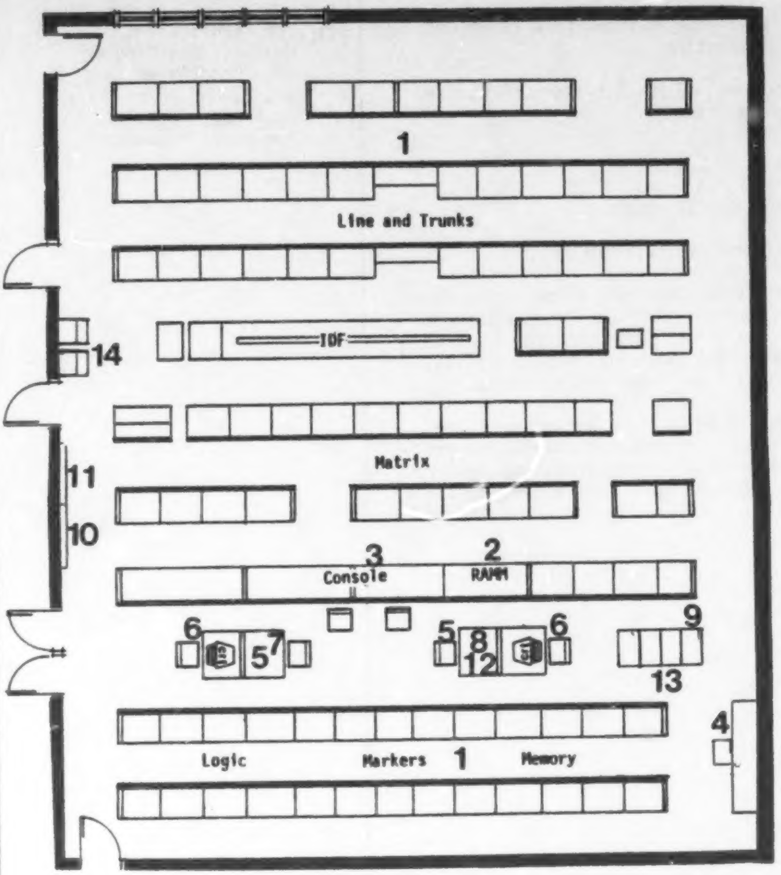
See Vol 2, SB4 for additional guidance.

activities	personnel	equipment*
1. Monitoring communication equipment (patch and test). 2. Isolating fault. 3. Performing quality control maintenance tests. 4. Troubleshooting and patching to good equipment. 5. Identifying bad connections. 6. Writing/typing reports. 7. Conducting training sessions.	1. Two to six personnel per shift, plus shift supervisor.	**1.** Electronic communication equipment. **2.** Computer unit (Rapid Access Maintenance Monitor--RAMM) with keyboard. **3.** Control console(s). **4.** Workbench (6 linear feet with shelving for manuals). **5.** Desk with chair. **6.** CRT at consoles with printer. **7.** Telephones. **8.** Typewriter(s)/word processor(s). **9.** Filesafe. **10.** Electrical shock first-aid kit. **11.** Alarm panel. **12.** Operational voice intercom control. **13.** Record file (10 drawers). **14.** Two scope carts.
Dial assistance area 1. Assisting dial users (when required).		**1.** Dial assistance console. * see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for equipment layout.	**1.** Space needs vary due to extent of communication equipment designed. See layout in Guidance.	
2. Enough space for storage and for accommodating the inspection and testing of communication equipment.	**2.** Provide a 48-inch workspace behind all radio equipment for inspection, testing, and repair.	
3. RFI shielding.	**3.** Shielding is required for electric and electronic components to prevent them from propagating interference and to protect them from interference propagated by other electronic devices.	**3.** See SB4, Grounding, Bonding, and Shielding, along with SB5, EMP/HEMP Protection. (Vol 2)
4. Raised floor system.	**4.** A raised or false floor system is required for proper cooling of electronic equipment.	**4.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
5. Interior finishes suitable for durability, maintenance, and room function.	**5.** Floor--vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor that has a dusted-on finish containing a hardener. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster, and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	**5.** See also Vol 2, SB2, Interior Construction and finishes.
6. Acoustical isolation and attenuation of variable noise levels produced by electrical equipment.	**6.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .25 (minimum). Acoustic tile also is required to within 4 feet of the floor.	
7. Adequate lighting.	**7.** Ambient: 20 footcandles. Task (Testing and inspection): 70 to 100 footcandles.	
8. Environmental control for proper operation of electronic equipment.	**8.** Temperature should be maintainable at 73°F (±2°F), with a relative humidity of 50 percent (±5 percent) and filtered air. (See MIL-HDBK-411A.)	**8.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
9. Electrical power.	**9.** Install 120/208 electrical service. Electricity may range from 10,000 to 50,000 watts. Voltages must be 50 to 60 hertz ±5 percent. Install 120-volt outlets for every 10 linear feet of wall and as required for coordination with equipment.	**9.** See also Vol 2, SB2, Communication Station Buildings--Electrical.

requirements	criteria	commentary
10. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical electronic equipment that have a severe strategic fire loss potential.	**10.** Vaulted enclosure walls--2-hour minimum fire-rated construction; shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or to constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area automatic fire detection--Local alarm; automatic Halon 1301 suppression system if cross-zoned or matrix detection is required. Sprinkler and Halon systems are not normally installed in the same areas.	**10.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

4. Raised floor systems

Most equipment that requires significant cooling to maintain communication operations should be located on a raised floor system so that maximum flow of cooled air directly through the cabinets is possible. Cooling air (60°F) supplied directly into the base of the transmitters will leave the top at approximately 72°F. When the air exits the equipment, it is at a more comfortable temperature for personnel working in the space.

7. Equipment area

Fixtures should be arranged above the operating aisles, running parallel to equipment row arrangements. They should be located so as not to cast shadows or reflections on the front of the technical equipment or to be obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RF interference filters (GE no. 89G635, Sprague IF-37, or equivalent). Lights shall not interfere with access to the cable trays or equipment. (23)12 Portable task lighting should also be supplied for the equipment area at 70-to 100 footcandles.

8. Protection from moisture migration

Operating spaces that contain electronic equipment usually require close control of temperature and humidity. Vapor barriers placed under floor slabs and incorporated into roofing usually prevent moisture migration into and out of interior electronic equipment spaces. However, additional protection must be provided when exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

Air-conditioning

Continuous, reliable operation of computer systems depends on an efficient, well designed, properly controlled air-conditioning system. Lack of adequate cooling contributes as much to failure as poorly regulated power. (74) 4-17

Even though certain individual units can operate outside the limits of the overall specifications, the system's environmental requirements are dictated by its most restrictive unit. Computer system requirements are the major considerations in air-conditioning system design. However, good design will also consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in the following ways: (74) 4-17

- Heat dissipation by the computers is relatively constant; therefore, year-round cooling is required.
- The computer room sensible heat ratio is near unity because all heat dissipated by the computer system is sensible.

guidance

- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The number of air changes per hour varies between 30 and 60 because of the computer equipment's high heat dissipation.
- Year-round humidity control is required to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended in electronic equipment areas because this can cause damage. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are required to provide a continuous record of temperature and humidity in the machine area. Also, if the air-conditioning requirements are not met, a record is available to indicate the extent and duration of the undesirable condition and to show whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-25

- Insure that the air-conditioning installation continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a drying-out period is necessary when humidity limitations are exceeded. Drying-out may be needed if the excess humidity occurs either during actual system operation or when the machine is shut down and unattended. The extent and duration of the excess humidity is used to determine the length of the drying-out period.
- Determine if the environment in the area meets the requirements for the machine.

A visual or audible signal in the instrument is desirable to indicate when temperature or humidity in the computer area is nearing maximum limit.

Direct-reading instruments with a 7-day electric-drive chart are sometimes used to monitor ambient room conditions in installations. The recorder is usually located at a representative point in the room and adjacent to the control devices.

A remote indicating instrument is recommended for monitoring the underfloor air. This is usually a 7-day electric-drive chart and can be the wet-and-dry bulb or electronic type if direct reading is not available. This instrument can be located on the wall in the room, in the mechanical equipment room, or at any other location convenient to the building engineer.

guidance

An air-conditioning system for a computer and switch installation sometimes requires dedicated supplies for each unit. Input is from below as shown in Figure VO-1. An alternative air source also should be made available.

guidance

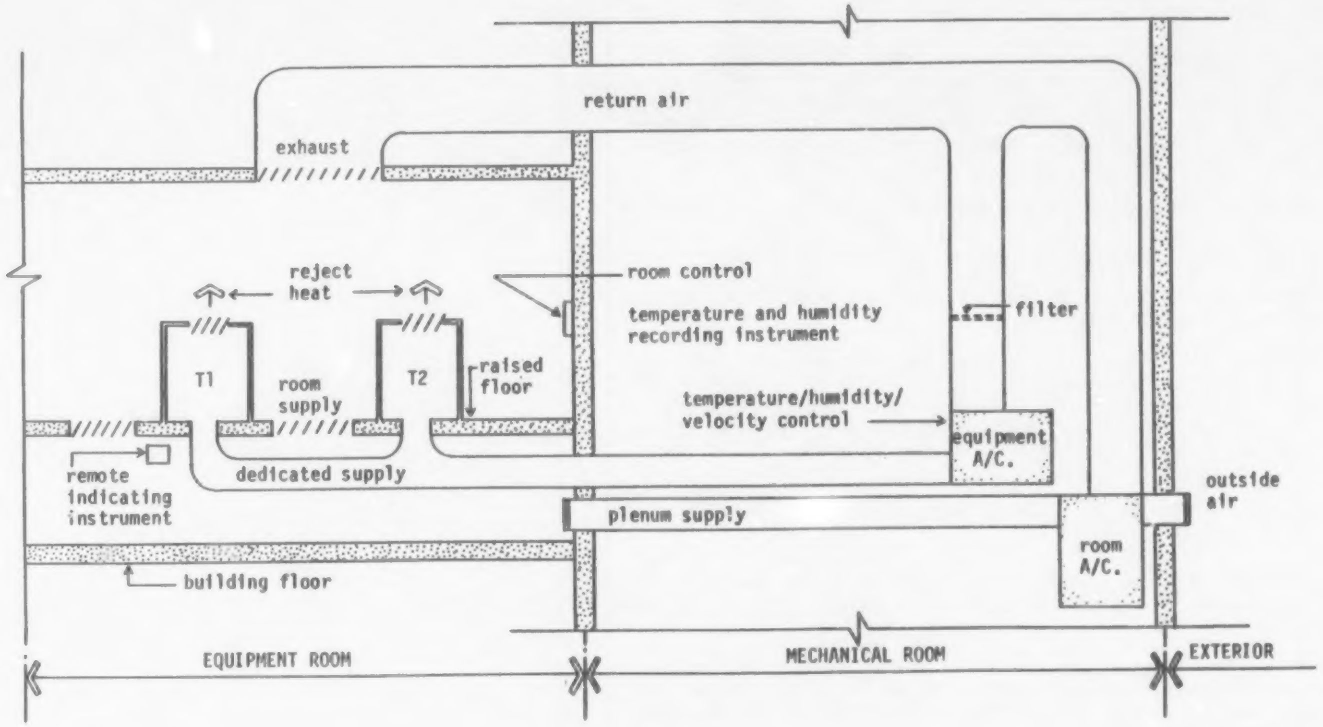
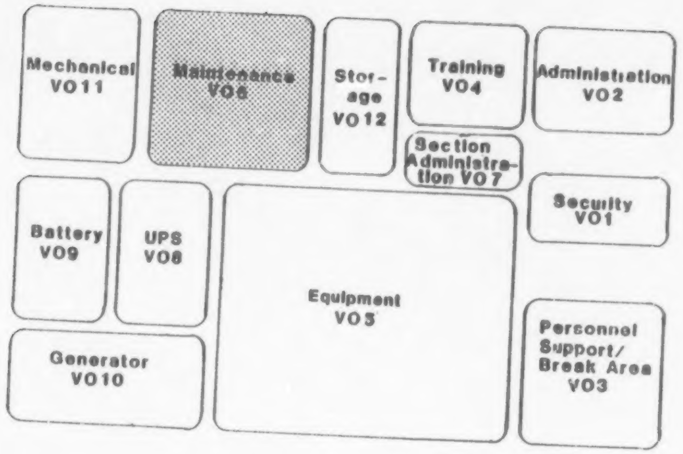

return air
exhaust
reject
heat
room control
temperature and humidity
recording instrument
filter
T1
room
supply
T2
raised
floor
temperature/humidity/
velocity control
equipment
A/C.
remote
indicating
instrument
dedicated supply
outside
air
plenum supply
room
A/C.
building floor
EQUIPMENT ROOM
MECHANICAL ROOM
EXTERIOR

FIGURE VO-1. AIR INPUT AND EXHAUST SCHEME FOR EQUIPMENT ROOM.

guidance

guidance

MAINTENANCE VO6


Mechanical
VO11
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VO12
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Administration
VO2
Section
Administra-
tion VO7
Security
VO1
Battery
VO9
UPS
VO8
Equipment
VO3
Generator
VO10
Personnel
Support/
Break Area
VO3

function

To provide an area for assigned personnel and the shift supervisor who repair, clean, and test communication equipment.

To provide administrative space that specifically supports the equipment maintenance activities (component trouble analysis and replacement).

policy/sop

1. It is desirable to provide a separate maintenance room to allow space for repair activities and the associated test equipment and tools. The space required will, of course, depend on the amount of electronic communication equipment installed, the number of maintenance personnel involved, and the spare parts stocking requirements.

2. To test and service a DCS communications system properly, maintenance personnel should have a thorough understanding of the equipment's physical makeup, operational characteristics, capabilities, and limitations, and should be familiar with the circuit theory of operation. It is equally important that the proper test equipment be available to these personnel. As the area of maintenance progresses from onsite field maintenance to depot maintenance, the amount and requirements of the test equipment needed to perform the maintenance procedures will increase, requiring improved facility responsiveness. (70) 7-51

3. Communication equipment maintenance requires specific information to be logged into maintenance reports that specify the type of work done, equipment used, equipment history, and parts used (inventory).

issues and assumptions

activities

1. Inspecting and diagnosing equipment and parts.
2. Completing preventive and unscheduled maintenance.
3. Assembling electronics.
4. Testing electronics.
5. Providing secure storage for parts and equipment.
6. Maintaining records on parts and equipment, and maintenance activity (maintenance logs).
7. Writing/typing reports:
   - o PMI 349s
   - o Equipment historical records.
8. Developing maintenance personnel training plans and equipment evaluations.

personnel

1. Two or three maintenance specialists.
2. Maintenance noncommissioned officer in charge.

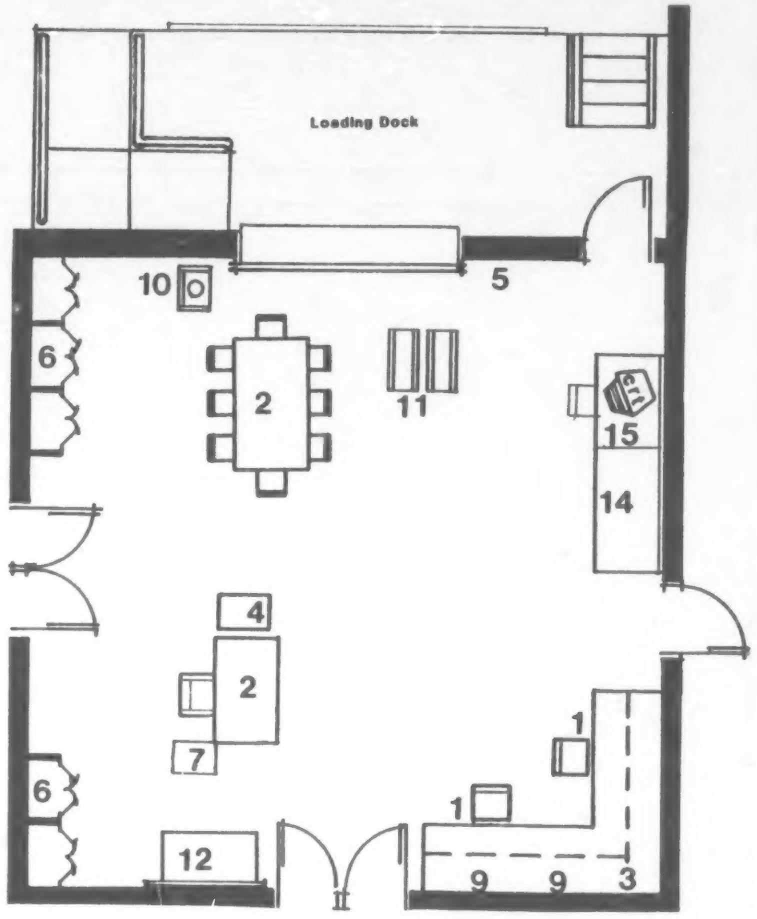
* see "guidance" box for example layout of all equipment listed.

equipment *

1. Two electronic workbenches with stools.
2. Two desks with chair, one with typing stand.
3. Shelving over workbench for publications.
4. File cabinet.
5. Portable vacuum cleaning system to clean equipment parts. If compressed air blower unit is used instead, use a maximum of 30 pounds per square inch to prevent damage to parts. (Use with a dust collector.)
6. Locked storage cabinets for special electronic equipment (secure to wall).
7. Typewriter/word processor.
8. Intercom speaker.
9. Wall-mounted test equipment over workbench.
10. Portable power supply test set.
11. Two scope carts.
12. Multiboard (24 by 48 inches).
13. Telephone.
14. Shelving for inactive equipment storage.
15. CRT terminal.

requirements	criteria	commentary
1. Enough space for inspection, disassembly, and reassembly of sensitive electronic equipment. Space must also accommodate administrative, tool, and part needs.	1. Provide approximately 900 square feet.	
2. A secure, controlled area.	2. The room should be lockable when unstaffed.	2. See Vol 2, SB7, Security (Zone 3) for more information.
3. Interior finishes suitable for durability, maintenance, and room function.	3. Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	3. See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation to eliminate C-E equipment noise to help personnel concentrate when they work on electronic components.	4. The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC. 90, floor surface at NRC .50, and divider partitions (if used) at .85.	
5. Adequate lighting.	5. Fixtures should provide 70 footcandles for ambient lighting and 150 footcandles for task lighting.	5. For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical Lighting.
6. Thermal regulation and other comfort features for occupants.	6. Regulate temperature at 68°F (heating), 78°F (cooling), with a 5-cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adustment, casters, swivel, and independent backrest adjustment.	6. See Also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	7. Install 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height for every 10 linear feet of wall. Provide four duplex outlets at each workbench. All equipment and workbenches must be grounded. Frequency levels should be 50 to 60 hertz ± 5 percent.	7. See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	8. Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	8. See Standardized Modules--Buildirg Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance


Loading Dock
10
5
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15
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12
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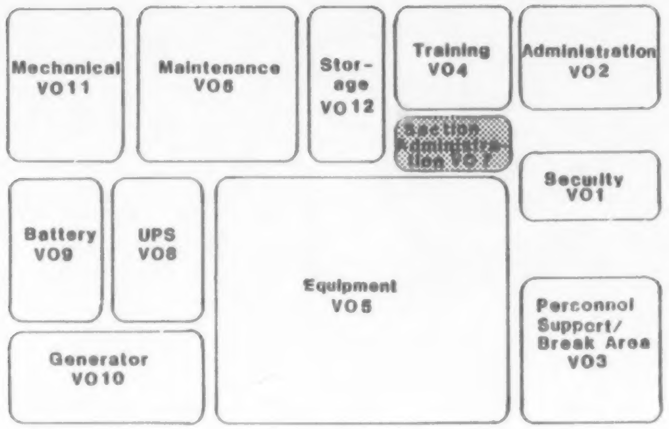
9
3

8-- speaker in ceiling

guidance

SECTION ADMINISTRATION VO7


Mechanical VO11
Maintenance VO6
Stor-age VO12
Training VO4
Administration VO2
Section Administration VO7
Security VO1
Battery VO9
UPS VO8
Equipment VO5
Generator VO10
Personnel Support/ Break Area VO3

function

To provide space that specifically supports the operating activities.

policy/sop

issues and assumptions

1. Enclosed office versus open area workstation

The NCOIC and his/her assistant usually occupy an office workstation in the operations room itself. This makes their work more difficult due to high noise and activity levels. If an enclosed office is provided, a view window to the console area must be installed.

2. Automated equipment information

Upgrading the system with in-house labor would help maintenance personnel responsiveness. CRT maintenance is a major function at communication facilities; therefore, large amounts of information are generated. An automated records system is needed for:

a. Equipment histories (for quality control).

b. Automated parts inventory.

c. Manuals and specifications.

d. Fault isolation for maintenance work by having the proper procedures on call.

activities

1. Distributing directives, orders, and policy statements, both written and verbal, to shift supervisors.
2. Planning for exercises and contingencies.
3. Managing operations function.
4. Conferring with personnel (one-on-one).
5. Writing/typing reports.
6. Communicating operations and service functions.

best copy available

personnel

1. Operations NCOIC.

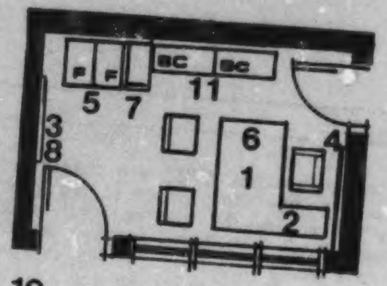
equipment*

1. Desk with chairs.
2. Typewriter, word processor with stand.
3. Tackboard.
4. Scheduling board (4 by 8 feet). Multiboard (4 by 8 feet).
5. Two file cabinets (five drawers each).
6. CRT terminal.
7. Filesafe, five drawers.
8. Station log.
9. Telephone.
10. Intercom speaker.
11. Bookshelves, 20 linear feet.

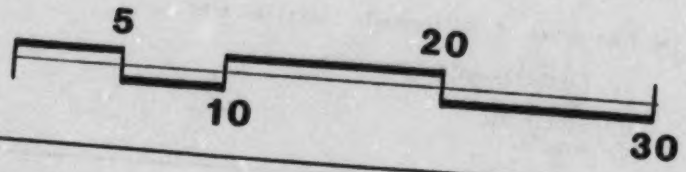
* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the administrative function.	1. Provide 150 square feet of enclosed administrative space.	
2. Interior finishes suitable for durability, maintenance, and room function.	2. Floor--Carpet. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	2. See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	3. The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	3. See reference 201, page 3-4, Table 3-2.
4. Adequate lighting.	4. General lighting: 20 to 50 footcandles; task lighting: 70 to 150 footcandles (provide adjustable arm fixtures); VDT use requires 5 to 10 footcandles. Surface reflectances: • Ceilings--80 to 90 percent • Walls--40 to 60 percent • Floor--20 to 40 percent.	4. For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for the occupant.	5. Maintain temperature at 68°F (heating), 78°F (cooling), with 5 cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	
6. Electrical power.	6. Provide 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	6. See also Vol 2, SB2, Communication Station Buildings--Electrical
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	7. Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	7. See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



10-- speaker in ceiling



guidance

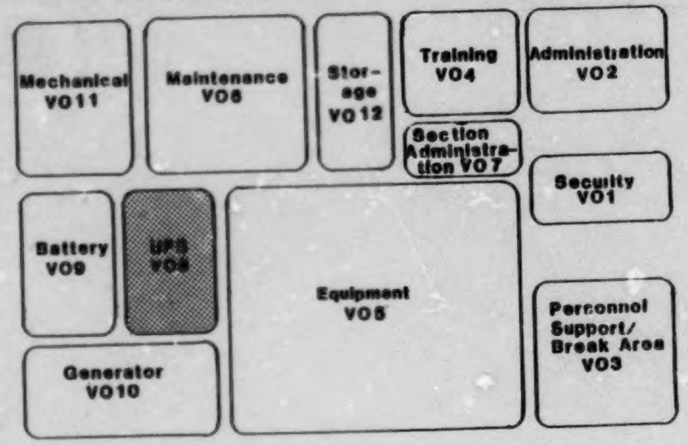
4. Lighting design

To reduce glare at video digital terminals (VDTs), use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values.

The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On tall ceilings, the cell depth must be greater; this may dictate a larger cell size.

Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

UPS VO8



function

To provide continuous power, without delay or transients, to the critical load.

policy/sop

Uninterruptible power systems (UPS) are characterized by the ability to condition primary or auxiliary power to the precise, high-quality power required by the C-E equipment. UPS maintain continuous power during transfer from one power source to another or for a long enough period to allow for an orderly shutdown. A UPS is required to maintain and provide continuous conditioned power to the critical C-E equipment and to provide protection from power-line transients.

Uninterruptible power system (UPS)

1. A UPS should serve the critical technical load. The UPS should be solid-state with batteries that can support 125 percent of the critical technical load for a minimum of 15 minutes. The UPS is designed to protect equipment from disturbances in voltage and frequency inherently present on conventional power distribution systems. The UPS must maintain output voltage and frequency, regardless of the nature or severity of the incoming line fluctuations and/or changes in load.

2. The UPS should operate in conjunction with the existing power distribution system to provide quality power for critical technical loads. The system should consist of a solid-state inverter, a battery charger/rectifier, storage batteries, and a static transfer switch with bypass switch.

3. During normal station operation, the UPS will be supplied with a.c. power by the primary power source--the UPS then changes the a.c. power into storable d.c. electrical energy to be used as a short-term, no-break power supply for critical equipment. The UPS uses only a small amount of energy to maintain the energy storage levels; the rest is reconverted into a.c. electrical energy. The UPS a.c. power input and output are isolated from each other by the energy storage medium. A way should be provided to bypass the UPS completely in the event of failure or required maintenance. (1) 150 Electronic components of a UPS should be in a room separate from the machinery and batteries to prevent vibration, pollution, overheating, and corrosion of the electronic components. See MIL-MIL-HDBK-411A for air-conditioning criteria.

The four types of UPS commonly installed are:

a. Flywheel--motor generator
b. Rotary
c. Electronic
d. Hybrid.

policy/sop

4. The power sources and distribution system should be dependable, free from disturbances, and easily maintained. Efficient operation of the earth complex requires a dependable power system that minimizes the number and length of communication outages. Added to the primary objective of dependability are: (a) cost effectiveness to provide the best possible system for the least amount of money and (b) standardization to aid in cost effectiveness, maintainability, and ease of support. Additional information is available in MIL-HDBK 411A AR 420-43, NAVFAC DM-4, NAVFAC DM12.1, AFM 88-15, and the National Electrical Code. (1) 30

5. A modern solid-state UPS is a reliable source of conditioned power. The UPS usually is provided with an electronically controlled static bypass switch when input and output frequencies are identical. The static switch permits automatic bypass if the UPS fails. Also, a manual bypass switch is often provided to permit maintenance on any part of the UPS system. (1) 153 Solid-state UPS have many advantages over mechanical rotary UPS. Bearing, vibration, and low efficiency problems are avoided, and single-point failures are minimized by selection and proper configuration of solid-state UPS. Reserve battery capacity of 15 minutes is normally enough for bringing the UPS online, at which time the auxiliary power plant should be providing the input power. (19) 17

   See Vol 2, SB2, for detailed information on UPS.

issues and assumptions

1. Selection of UPS

   Single UPS--The single, static UPS has the advantage of simplicity and low cost. The single UPS configuration consists of a rectifier, an inverter, associated controls, protective devices, and an energy storage battery. This system also includes a static bypass circuit that automatically transfers the critical load to the alternate power source without an interruption to the load. When an inverter output failure is sensed, the critical load is transferred to the bypass circuit in less than 5 milliseconds. The synchronous bypass adds about 20 percent to the cost and provides eight to ten times more reliability. UPS failure causes the static switch to transfer the load to the input source, keeping the load online. When selecting this configuration, two conditions must be considered for successful operation: (a) the transfer must be fast enough that the load will not be disconnected and (b) the frequencies and voltages of the primary power and the inverter output must be the same.

   Parallel redundant system--This system consists of at least two UPS operating in a load-sharing mode. The output of each is normally connected to the bus through a static interrupter for protection. If an internal fault occurs within an inverter of either system, the static interrupter isolates that inverter from the bus. In case of a bus fault, the interrupter operates in a current limiting mode until the output circuit breaker trips. Parallel UPS may be configured for various combinations of units operating in parallel, such as three units on-line with any two capable of serving the load. Parallel configuration is recommended when the frequency of the primary electric power supply must be converted to serve the critical load such as 50 to 60 hertz.

   "Cold" standby independent UPS--This configuration consists of two independent UPS with a common battery. One UPS is online and the other is in "cold" standby. Both UPS are equipped with static bypass circuits that, in the event of UPS failure, automatically transfer the critical load to the primary or auxiliary power source without interruption. The second UPS is then energized manually and placed in the bypass mode and the critical load is assumed by the transfer action of the static switch. The two UPS are not intended to operate in parallel and interlock circuits are provided on the UPS output.

issues and assumptions

2. Float battery systems versus solid-state UPS

The float battery system is the most economical and reliable method of providing continuous d.c. power to critical loads. Since this system is inherently very reliable and since future power sources (renewable energy) provide d.c. power, long-range communications plans call for increased use of d.c.-powered electronics. (19) 10

Floating battery power should be designed for optimal reliability and maximal independence of primary power abnormalities. The battery should be sized to furnish full power to the critical technical load for a period consistent with requirements and system design for auxiliary power capabilities. The battery system supporting solid-state UPS should be sized for 15 minutes in most cases. For 48-volt applications, if specific battery operation requirements are not available, the batteries should be sized for 4-hour operation at attended sites and a minimum of 8 hours' operation at unattended sites. A single float battery system should be designed for all float battery requirements in a common facility. A minimum of two rectifier chargers should be provided. The total number of rectifiers required will be determined by the number needed to supply the load and battery charging current, plus one or more for the maintenance space. When operating on commercial power, the rectifiers should be sized to provide a battery recharge-to-discharge time ratio of not more than 30 to 1. When static inverters are used, provisions should be made to transfer the load gradually from the battery to the primary or auxiliary power source. This provision, normally handled by the rectifier, will minimize transient conditions on the primary or auxiliary power source during the transfer period. (19) 22

activities

1. Doing prescribed maintenance and inspection (PMI) work.
2. Conducting operational checks and load tests.

personnel

1. One, though not located in room continuously.

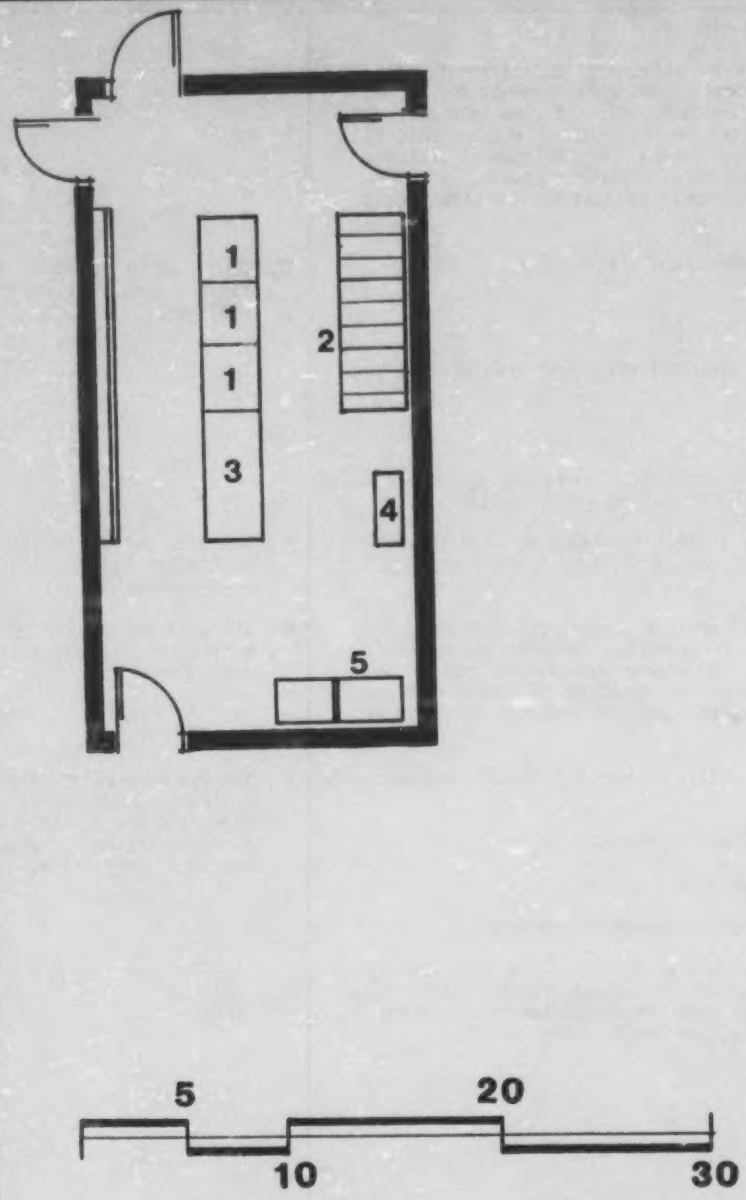
equipment *

1. Solid-state rectifier/charger.
2. Batteries.
3. Inverter, synchronizing equipment.
4. Static switches.
5. Rotary converter (if 60-hertz equipment is used in a 50-hertz host country.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for the operation and monitoring of UPS equipment; proper spacing between equipment for easy maintenance.	**1.** Space needs vary with the communication equipment design (i.e., power requirements), but an average is 400 to 500 square feet. Depending on UPS capacity, certain components are very large and heavy, so consideration must be given to installation and repair or replacement of those items. To accommodate this, knock-out panels may be required. Cable ducts should be located for easy access and drainage.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for variable noise levels produced by electronic equipment.	**3.** Adjacent room walls should limit sound transmission to 40 decibels.	
4. Adequate lighting.	Provide 20-footcandle (ambient) fluorescent fixtures and 70 footcandles (task) for testing and inspection.	
5. Environmental control for proper operation of electronic equipment.	**5.** Regulate temperature at 50°F for heating. Cooling temperature must be less than 90°F for all solid-state UPS equipment.	**5.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
6. Electrical power.	**6.** Commercial electrical service used in the building will be site-specific. Availability depends on the host country if OCONUS. An outdoor transformer can be installed for UPS spaces in terms of the communication equipment and switchgear. Provide 120-volt receptacles as needed.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior enclosure walls--1-hour fire-rated construction. Interior doors--20-minute fire-rated doors. Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location:

The UPS and associated battery should be installed in separate rooms. The construction should be of permanent type and the wall separating the UPS should be fire rated (see SB3). Continuity of power during emergency periods of power transfer is maintained by an energy storage battery. Reserve battery capacity of fifteen minutes is normally sufficient for UPS application, at which time the auxiliary power should be providing the input power.

Structural:

Minimum Floor Load - 250 psf

A clear ceiling height of 10 ft. (3.05m) should be provided.

Doors:

All doors to the UPS room should be of steel construction and should have a minimum dimension of 4.0 x 7.0 ft. (1.22m x 2.14m) Consideration may be given to installing a louvered bottom door panel on the interior door(s).

5. Environmental Control:

Consideration should be given to installing solid state UPS in an environmentally controlled room where adverse environmental conditions exist or when recommended by the UPS manufacturer.

guidance

Figure VO-2 and VO-3 shows the preferred method of heating and ventilating UPS equipment areas, as well as providing the required ventilation system redundancy. The canopy hood, also called a "receiving hood," should be slightly larger than the equipment or exhaust grills in the cabinets and should extend fairly close to them. Direct connections should be avoided unless specifically recommended by the equipment manufacturer. Each exhaust fan should be sized to handle all the air exhausted through the cabinets plus 10 percent (room air) to insure good capture. (5) 3-3-13.

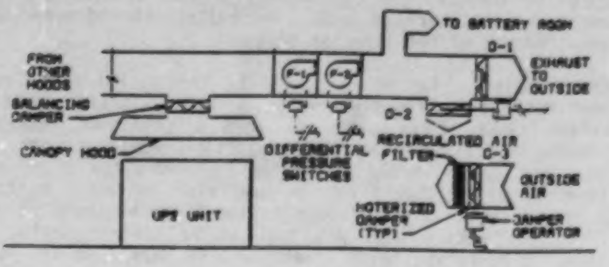

TO BATTERY ROOM
D-1
FROM OTHER HOODS
F-1
F-2
EXHAUST TO OUTSIDE
BALANCING DAMPER
D-2
CANOPY HOOD
DIFFERENTIAL PRESSURE SWITCHES
RECIRCULATED AIR
FILTER
D-3
OUTSIDE AIR
UPS UNIT
MOTORIZED DAMPER (TYP)
DAMPER OPERATOR

FIGURE VO-2 SERIES FAN ARRANGEMENT. (5) 3-3-14

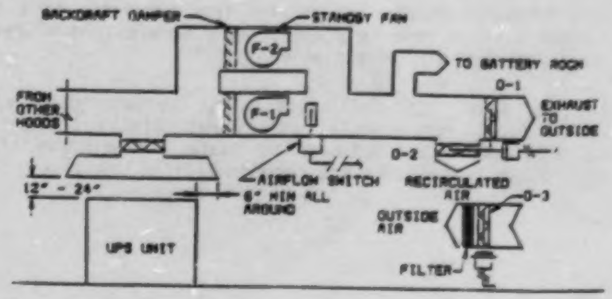
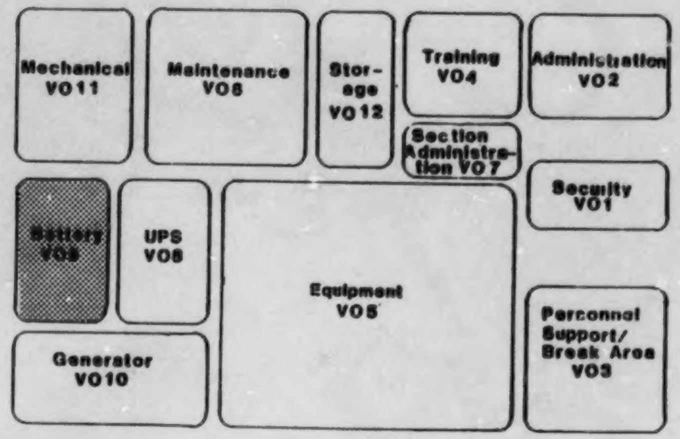

BACKDRAFT DAMPER
STANDBY FAN
F-2
TO BATTERY ROOM
D-1
FROM OTHER HOODS
F-1
EXHAUST TO OUTSIDE
D-2
AIRFLOW SWITCH
RECIRCULATED AIR
12" - 24"
6" MIN ALL AROUND
D-3
OUTSIDE AIR
UPS UNIT
FILTER

FIGURE VO-3 PARALLEL FAN ARRANGEMENT. (5) 3-3-14

guidance

BATTERY VO9


Mechanical
VO11
Maintenance
VO6
Stor-
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VO12
Training
VO4
Administration
VO2
Section
Administra-
tion VO7
Security
VO1
Battery
VO9
UPS
VO8
Equipment
VO5
Personnel
Support/
Break Area
VO3
Generator
VO10

function

The battery room houses batteries that help comprise the backup power system (UPS), a system designed to provide continuous power to the critical load without delay.

policy/sop

1. Battery bank. This should be used as a stored energy source for the UPS. The battery's ampere-hour rating should be high enough to support the inverter for the protection time specified with the mover for operating at rated load. The battery should meet input voltage requirements of the inverter section.

2. Construction. Batteries should be the sealed type, assembled in heat-resistant, shock-absorbing, clear plastic containers with covers cemented in place to form a permanent leak-proof seal. Covers should be fitted with explosion-resistant vent caps. Cell post and cover should be sealed by lead-alloy steel nuts. Cell terminal posts should be equipped with connector bolts that have acid-resistant nuts. Enough sediment space should be provided so that the battery will not have to be cleaned during its normal life. Electrolyte level lines shall be marked on all four sides of the container.

3. Ground protection. The battery should have a high-resistance ground and a ground detection alarm for maximum safety; this will be an integral part of the UPS.

4. UPS batteries should be isolated from machinery in a properly designed battery room to prevent their damage from vibration, pollution, overheating, or explosion.

5. Battery Rack: At all sites, the seismic category should be considered. For example, safety restraint rails are recommended to hold batteries securely in place. A minimum of category I earthquake proof racks are recommended for use at all locations.

issues and assumptions

1. Batteries versus generators for "backup" power

The use of batteries as the only backup power is impractical at high-power communications facilities. Some use can be made of batteries for backup at receiving facilities and possibly for low-power (up to 1 kilowatt) transmitter radio facilities, but even this is questionable. Normally, there will be engine-driven generators at the facility to pick up the load within approximately 1 minute of the power failure. Maintaining large banks of batteries for use during an occasional power outage may not be cost-effective. (87) Vol 2, 86

activities

1. Inspecting battery system quarterly.

personnel

1. None assigned fulltime.

equipment*

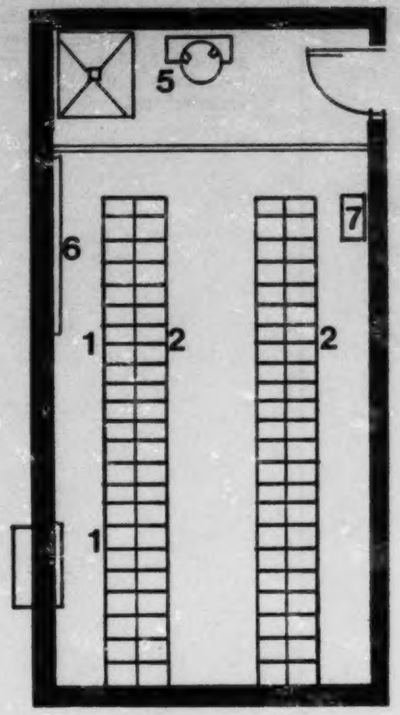
1. Lead acid batteries.
2. Battery racks.
3. Rectifier chargers.
4. Counter workbench for battery maintenance.
5. Emergency eyewash fountain and shower.
6. Safety board, 96 by 48 inches, wall-mounted.
7. Four cans of soda and four jars of distilled water.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for batteries and rectifier chargers to contain the proper safety equipment associated with the battery function.	1. Approximately 450 square feet are needed to provide space for battery racks, rectifier chargers, and the emergency eyewash and shower equipment.	
2. Interior finishes suitable for durability, maintenance, and room function.	2. Floor--Concrete, hardened and sealed. The battery room requires treatment with an acid-resistant floor hardener. Base--Not applicable. Walls-- Paint with tile wainscot of 48 inches. Ceiling--Exposed and painted.	2. See also Vol 2--"Site and Building Information," SB2, Interior Construction and Finishes.
3. Acoustical isolation for adjacent mechanical equipment rooms that produce variable noise levels.	3. Adjacent room walls should limit sound transmission to 40 decibels.	
4. Acid removal.	4. A special drain system is needed to accommodate acid spills. Provide a curb to contain acid and keep it from entering the shower drainage area.	4. The battery room contains highly explosive fluids and fumes. It is important that item specifications be explosion-proof and meet Occupational Safety and Health Administration (OSHA) regulations.
Safety board.	5. Use 96- by 48-inch mounted board for assigned safety gear and a large enough floor area to store four cans of soda and four jars of distilled water.	
6. Separate exhaust ventilation system to outside.	6. An interlock must be provided to deenergize charging circuits if ventilation fails or shuts down. See SB2, Special Mechanical Systems, for ventilation rates.	6. See note 2 of Issues and Assumptions of SB2, Vol. 2.
7. Adequate lighting.	7. Use 60-footcandle fluorescent lighting in corrosion- and explosion proof fixtures	
8. Thermal comfort.	8. Maintain temperature at 60°F for heating. 104°F is the maximum allowable temperature.	8. See also Vol 2, SB2, Communication Station Buildings, Mechanical.
9. Electrical power.	9. Provide 120/208 electrical service. All 120-volt fixtures and switches are to be Class II. Locate one receptacle for every 10 linear feet of wall. Metal battery racks will be grounded to the earth ground system. (Explosion-proof electrical receptacles and fixture explosion venting are not required, but are recommended.)	9. See also Vol 2, SB2, Communication Station Buildings, Electrical. Air Force recommends no receptacles in Battery and will not usually use electrical equipment in room.

requirements	criteria	commentary
10. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**10.** Interior enclosure walls--1-hour fire-rated construction Interior doors--20-minute fire-rated doors Interior finish--Class A or B only Automatic fire suppression--Water sprinklers Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility Explosion-proof electrical receptacles and fixture explosion venting.	**10.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



3. Rectifier chargers may not be physically co-located with the batteries.

guidance

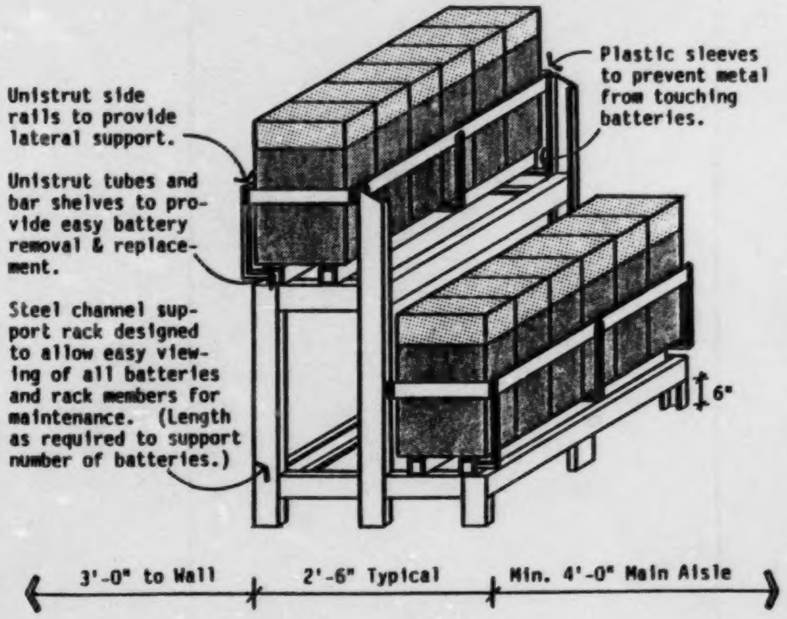
1. Location

Battery rooms, consisting of cells mounted on manufacturer-supplied battery racks, are normally adjacent to the UPS equipment room. The battery room should be windowless, reasonably well insulated against heat loss and gain, and located to minimize solar gain. Frequency conversion equipment should be as close as possible to the equipment it serves. Motor generators should be located in a separate room to reduce noise levels and heat gains in operating spaces. Static converters can be located in the equipment space or operating space because they produce minimal heat and noise. (92) 12.1-12

Spatial needs

The 48-volt d.c. battery set consists of 24 cells with interconnections, mounted in a two-tier seismic-resistant rack.

A suitable galvanized steel rack should be furnished. Lead-plated copper interrack connectors and cell numbers should be provided. Plastic covers should be provided to insulate rails and cells. Racks should be painted with two coats of acid-resistant paint.


Unistrut side rails to provide lateral support.
Unistrut tubes and bar shelves to provide easy battery removal & replacement.
Steel channel support rack designed to allow easy viewing of all batteries and rack members for maintenance. (Length as required to support number of batteries.)
Plastic sleeves to prevent metal from touching batteries.
6"
3'-0" to Wall
2'-6" Typical
Min. 4'-0" Main Aisle

TYPICAL BATTERY STORAGE RACK

guidance

The 48-volt d.c. power can consist of two, three, or four rectifiers with storage batteries sized properly to meet each site's power requirements. The rectifiers can be operated in a parallel/redundant mode, which extends the equipment life and provides uninterrupted service should one cell fail. Rectifiers should have a "current walk-in" feature for a smooth increase in current with initial power-up to protect the load and prevent accidental circuit breaker tripping. Rectifiers also should have a current limit control that can be adjusted from 90 to 125 percent to limit the output current. A voltmeter and an ammeter can indicate rectifier operation and front panel alarm lights are available for external monitoring. Battery plant capacity should be sized to support the total load. (88)G-1

2. Durable surfaces

All floors, walls, and ceilings should be made of acid-resistant materials. Exposed concrete is recommended for the floor.

All doors to the battery room should be constructed of steel and should have a minimum dimension of 4.0 by 7.0 feet (1.22 by 2.14 meters). Consider installing a louvered bottom panel on the interior door(s).

Exhaust fans in the battery room should be covered with security bars and be explosion-proof. See SB7 in Vol. 2.

The battery room floor design load should be 250 pounds per square foot (1220 kilograms per square meter).

4. Acid Removal

All required actions must be taken to meet host country laws and regulations against the water and air pollution. An acid-resistant drain line should be installed between the battery room floor drain and the "pumpable" holding tank for chemical waste. Connections to sewage lines is unacceptable. Vent lines also should be acid-resistant.

6. Exhaust ventilation

The battery room is to be supplied with its own ventilation intake and exhaust ports to outside air. (40) 6-8

The central ventilation system supporting air to and exhausting air from the building can be used to supply air to the battery room for exhausting to the outside. (40) 6-8

Battery rooms shall be ventilated with nonsparking, explosion-proof, continuously operating exhaust fans to maintain a stable room pressure that is lower than that in adjoining rooms to prevent the outflow of contaminated air to other rooms. Required outdoor air ventilation rates for batteries and equipment shall be obtained from the manufacturer and shall be used in designing the environmental control system.

guidance

The battery room is normally ventilated by wall fans or power roof ventilators. Fans are sized so that either is adequate to limit hydrogen gas buildup to 2 percent. Both fans should have manual starters. If wall-mounted, they should be high enough to avoid hydrogen buildup near the ceiling. Backup electrical unit heaters sized to maintain a minimum temperature of 60°F (15°C) should be provided for times when waste heat is not enough to maintain the battery room temperature at its winter design level. Heaters should be on the utility or normal power circuit.

7. Lighting design

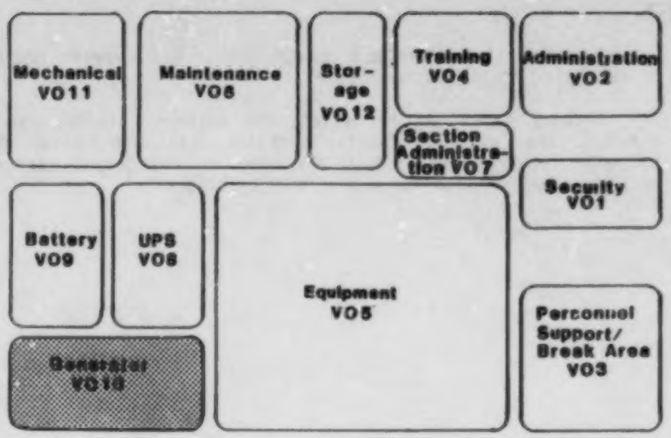
Explosion-proof fluorescent lighting fixtures should be installed in the battery room. Lighting levels in the battery room should be no less than 30 footcandles, 25 measured 30 inches from the floor. The light switch should be located outside of the battery room on the wall next to the door.

10. Life safety

A combination emergency deluge shower and eyewash fountain should be installed in the battery room.

Battery Rack: At all sites, the seismic category should be considered. For example, safety restraint rails are recommended to hold batteries securely in place. A minimum of category I earthquake proof racks are recommended for use at all locations.

GENERATOR VO10



function

To maintain power to all communication systems when commercial power fails.

policy/sop

1. Facilities usually have three generators as a backup power source in the event of commercial power failure:

   a. One generator will be online, set for automatic startup.
   b. Another will back up the first in case the first generator should fail.
   c. A third generator will be considered to be "in maintenance" condition to be available if the backup generator fails.

   See MIL-HDBK 411A for specific policy on the various generator classes.

2. Primary power requirements for a communications facility are determined by the system configuration and include equipment loads (technical power), utility and domestic loads, and provisions for future expansion. The architecture and engineering agency is responsible for designing the site primary power system and its distribution. One of the most economical, convenient sources of auxiliary power is the diesel engine-generator. However, an engine-driven-generator requires time to start and warm up, causing a delay before assuming the load after a power failure. Recommended practice is to use storage batteries to provide power instantly and economically. They can be kept fully charged by the primary power source during normal operation and, when failure occurs, the batteries assume the load immediately without interruption to service. Batteries cannot supply power for a long time, however, so it is necessary to have an auxiliary generator available. (70) 15-11

3. On-station prime power plants are considered only when the local power supply is either extremely unreliable or prohibitively expensive, when no power is available, or when self-sufficiency is required for survival and reliability in a wartime environment. On-station prime power plants normally use multiple sets of DOD standard family diesel engine generator sets as the power source. Other sources (such as wind turbines, thermoelectric generators, fuel cells, gas turbine generators, steam turbine generators, and nonstandard diesel engine generators) can also be used and should be considered when requirements for a wartime DCS dictate their use. An on-station prime power plant will use a minimum of three engine generator sets, with one set online and carrying the station load, one as a standby, and one as a maintenance spare. A more reliable configuration is to use four of five generator sets with two sets online in a load-sharing mode, one as a cold standby unit, and one or two as maintenance spares. When the station's standby power requirements exceed 70 percent of the total power requirements and the

policy / sop

percent of the total power requirements and the standby power is redundant, a study should be done in accordance with DOD 4270.1-M to determine if it would be more economical to provide a total energy system that produces both electrical and steam power to be used as needed. (1) 31

4. Site personnel efficiency will be improved if it is possible to locate noisy mechanical equipment, like some diesel generators, away in housing separate from working and living areas or if some other type of noise control is provided. Also, care must be taken to insure that fresh air intakes do not catch fumes or odors from sources such as diesel generators. (2) 5-25

5. All onsite power sources (generators) and substations should be located at a point in the station boundary for which security is adequate. Additional guidelines for locating power sources and substations are: (1) 32

   a. The primary onsite power source should be located far enough from the station work areas to insure acceptable noise levels as outlined by the acoustical noise requirements of MIL-STD-1472.

   b. The primary substation should be located for convenient delivery of power from an off-station source and for easy distribution of the power to onsite facilities as required.

   c. Distribution substations should be located as close as possible to the parts of the operating building they serve.

6. Total fuel storage tank capacity should be determined by local replenishment opportunities, but should hold at least a 30-day supply for primary Class A on-station generators per MIL HDBK 411A. Class C generators require a 7-day minimum supply and Class B generators require a 15-day minimum stored fuel supply. The storage tank(s) should be constructed of fiberglass and when practical, installed underground on an incline to prevent sediment accumulation. Provisions should be made for easy filling and removal of water and other sediment. (19) 13.

issues and assumptions

1. Commercial power versus generators

The mission of DCS communication facilities is to provide reliable communications 24 hours per day. Ideally, the power source for the mission equipment should be reliable, well regulated, easily maintained, and free of transients and disturbances. In actual practice, these desirable characteristics are seldom achieved on a long-term basis. Other factors to be considered in the choice of a facility power supply are:

   a. Providing the best possible system for the least amount of money (cost effectiveness).

   b. Standardizing for better cost effectiveness.

   c. Providing easy support (maintainability). (87) Vol 2, 62

Normally, a DCS communications facility will operate from commercial power using local generators for backup. In some areas of the world, however, commercial power may not be available or if it is, it may be so unreliable as to be unusable for the technical load. Such supplies may be satisfactory for the nontechnical load (area lighting, housing, etc.). In such cases, the primary power source should consist of generators located on the facility site. (87) Vol 2, 83

2. Comparison of engine generators

The selection of an engine generator to supply an independent power source (primary and/or standby) depends on several factors. The choice is usually between a diesel and a gasoline engine. Each has properties that determine its suitability for a particular application.

The diesel engine is suitable for either continuous or part-time service. Initial cost is slightly higher than that of a comparable gasoline engine; for certain applications, however, this disadvantage is more than offset by advantages. The diesel engine is extremely rugged, uses less and lower cost fuel, has a long life expectancy, and offers maximal reliability. Reasons for these advantages include (a) diesel fuel has a higher energy content than gasoline or liquid petroleum, (b) diesel engine operating speed is approximately half that of the gasoline engine, and (c) the diesel engine does not require an electrical ignition system. The last two factors account for lower maintenance and overhaul costs for the diesel engine. Engine starting time is comparable for diesel and gasoline engines.

Gasoline engines can be used for continuous power, but are better suited for standby use. As mentioned previously, the gasoline engine has a lower initial cost, but also a shorter life expectancy. It has a higher operating speed, which wears out the engine more rapidly. It uses more and higher operating speeds, which also wear the engine out more rapidly. It uses more and higher cost fuel and is not as reliable as a diesel engine. One reason for poor reliability is that a gasoline engine uses an electrical ignition system which is subject to failure due to dampness, age, and carbon buildup. (70) 14-3

issues and assumptions

3. Level of maintenance performed

If depot level maintenance is required and authorized, an open area, benches, and special tools (torque wrenches) also are required in the generator room. This is especially true at Navy installations, which require more extensive repair onsite.

4. Above-ground versus below-ground oil storage tank

To insure protection from hostile attack, below-ground tanks provide better security for the standby power system; however, above-ground tanks are cleaned, repaired, and maintained more efficiently, effectively, and economically.

5. Sizing generator fuel tanks

Engine generator size depends on the station's power requirements. The fuel tank capacity for these units depends on the site's accessibility and the size of the engine generators. It should not be necessary to refill fuel tanks more than once a month. If inclement weather or undue hardship dictates a longer period of time between refuelings, a larger tank is recommended. The approximate rate of fuel consumption of a diesel-driven generator, in gallons per hour, can be calculated by multiplying the output in kilowatts by 0.136; this calculation will be helpful in determining the size of tank needed. (70) 14-2

activities

1. Starting the on-line generators after commercial power failure.
2. Repairing and maintaining generators.

personnel

1. Two personnel, though not in room continuously.

equipment**

1. One "set" of generators.* (Usually Class C.)
2. Batteries for start-up.
3. Fuel tank with dispensing pump. (Tank capacity varies with size of generators and reliability level of primary commercial power.)

   See MIL-HDBK 411 for the specific capacity in relationship to a class of generators.
4. Alarm panel.
5. Automatic transfer switches.

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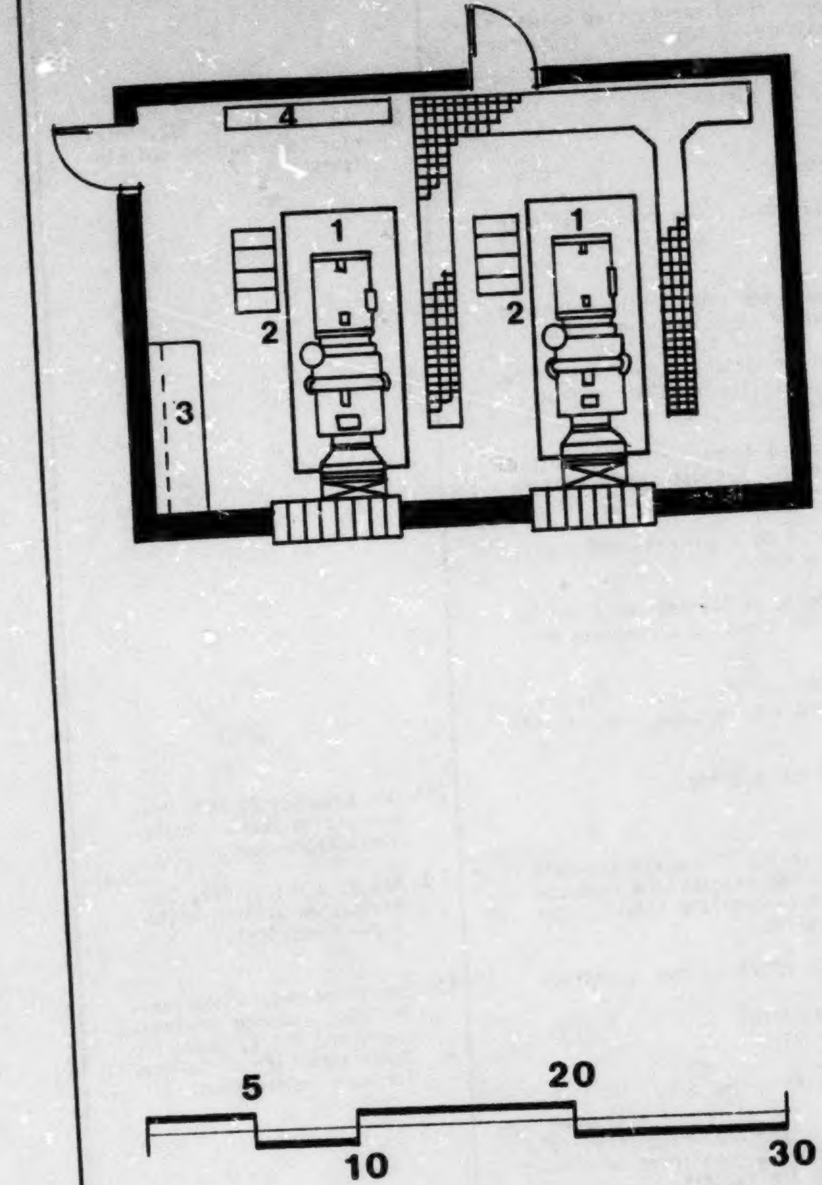
*The number and size of generators will vary among facilities depending on the voltage required to maintain the mission.

** see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for the installation, removal, and repair of standby generators.	**1.** Space needs vary with power requirements (see guidance drawing). Allow approximately 600 square feet for two generators.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustic isolation for variable noise levels produced by mechanical equipment.	**3.** Adjacent room walls should limit sound transmission to 40 decibels.	
4. Generator operation indicator and alarms.	**4.** An alarm and operation indicator panel will be located at the control console area of the operations space.	
5. Emergency lighting.	**5.** Emergency lighting should be bright enough to allow switch gear operation, instruction reading, and other mission-essential activities.	
6. Environmental control to provide generators' constant supply of make-up air for combustion and cooling.	**6.** Provide automatically adjusted louver units sized for capacity of generator selected. Exhaust stacks must be caged to prevent bird/animal entry.	
7. Vibration control.	**7.** The generators must be placed on a concrete pad physically isolated from the main floor.	
8. Design that allows complete removal and exchange of generator units.	**8.** Air intake/exhaust units should be located and sized to become a "knock-out" panel for removing a complete generator.	
9. Adequate lighting.	**9.** Use 40 footcandles (ambient). "Slow start" fixtures such as mercury vapor should not be used, nor should fluorescent fixtures.	
10. Thermal comfort.	**10.** Regulate temperature at 50°F for heating.	**10.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
11. Electrical power.	**11.** Provide 120/208 electrical service. Install 120-volt outlets; at least two duplex receptacles are required at workbench areas and at the appropriate height. Use 240-volt receptacles when required.	**11.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
12. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**12.** Interior enclosure walls--1-hour fire-rated construction. Interior doors--20-minute fire-rated. Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**12.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location

If a standby generator is to operate continuously for instantaneous commercial power backup, the generator room should be located away from all normal operational spaces to isolate the noise.

Clearances--All ducts and other systems installed in the facility as part of the finished structure should be arranged to maintain a 10-foot unobstructed clearance from the floor to the ceiling.

Structural--Isolate the foundations of each generator to prevent transfer of engine vibrations to the building. Floor loading should be designed to accommodate a steady load of the heaviest auxiliary diesel engine generator designed/selected by the contractor. Pad dimensions may exceed the engine dimensions by 25 to 30 percent.

Doors--All single doors should be constructed of steel and should have a minimum dimension of 4.0 by 7.0 feet. The exterior equipment door for the generator room should be double-wing type with minimum dimensions of 6.0 by 7.0 feet. This door should be equipped with a drop-in horizontal bar to secure it from the inside.

Storage tank--When required, provide an underground fuel oil storage tank adjacent to the power/mechanical room. Also provide fuel oil supply and return lines, fill pipe, oil level gage, and alarm conduits. This tank must be equipped with a float switch to activate an alarm indicating a low fuel oil condition.

A single storage tank should be provided for a minimum fuel supply for both the heating boiler and diesel engine generators. MIL HDMB 411A requires Class C generators to reserve a 7-day supply, Class B generators should reserve a 15-day supply, and Class A generators should reserve a 30-day supply. A fiberglass underground tank should be used. A day tank should be provided in the building to supply fuel to both the heating boiler and diesel engine generators. (See also Vol. 2, SB1, Site Planning and Development).

Provide floor trenches in the power/mechanical room for supply and return fuel lines from the exterior fuel oil storage tank and for cable runs from the generator to the transfer switch and main distribution panel. Floor trenches should have 0.25-inch-thick steel plate covers.

guidance

4. Alarm system

Provide a wall-mounted alarm terminal panel in the generator room. The following alarms will be terminated there:

- Generator status
- Commercial power status
- Low fuel oil level (48-hour supply)
- High (80°F) or low (55°F) temperature status in communication equipment and power mechanical room
- Generator start failure.

The termination board or its associated housing should have all alarm terminations identified clearly with permanent marking or labels for future extensions of these connections to a control and fault alarm system. The alarm sensors should incorporate only dry contacts (no voltages) and should use two conductor shielded cables in the circuit runs or in conduit to the consolidated terminal panel noted above.

Provide adequate grounding cable from the building ring ground system, when applicable, to the diesel generator set metal frame and to the underground fuel oil storage tank. See Vol 2, SB4.

6. Environmental control

Generator exhausts should be located such that fumes will not be sucked into other HVAC air intakes. Emergency generators can be located inside the operations building if they are isolated properly from the rest of the structure in terms of fire protection, sound attenuation, and vibration control. (92) 12.1-12

Louvers and Openings

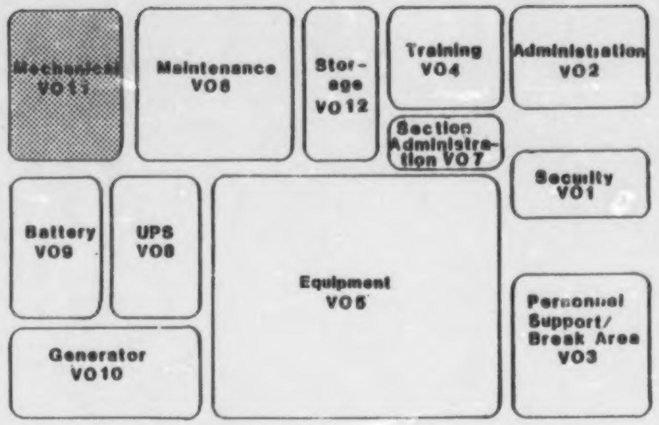
Provide motorized air damper openings in the generator room walls to accommodate diesel engine combustion air requirements. Dampers should automatically activate when generator starts.

Provide security bars on all openings subject to physical intrusion (greater than 7.6 feet in perimeter) such as air intake and exhaust louvers. Their attachment to the structure must be nonremovable from the exterior.

See Vol 2, SB7, for security guidance.

guidance

MECHANICAL VO11


Mechanical VO11
Maintenance VO6
Stor-age VO12
Training VO4
Administration VO2
Section Administration VO7
Security VO1
Battery VO9
UPS VO8
Equipment VO5
Personnel Support/ Break Area VO3
Generator VO10

function

This module provides space for equipment to supply all the heating, ventilating, and air-conditioning (HVAC) and water requirements for the entire facility. It must also be flexible and spacious enough to accommodate alternative energy sources.

policy/sop

1. It is desirable to provide a separate room for mechanical equipment such as heat exchangers, air-conditioners, and waveguide dehydrators-pressurizers. Heat exchangers must have air intake and exhaust ducts to the outside of the building. The size of these ducts dictates that heat exchangers must be located close to the wall. It must not be overlooked that some types of heat exchangers may require rear access for maintenance. Location of the dehydrating-pressurizing equipment is not critical. However, ease of access for maintenance is desirable and the pressure gages should be readily visible to the maintenance personnel. The air-conditioning equipment location will depend on the specific type provided and whether or not intake and outside exhaust are required. (2) 5-24

issues and assumptions

1. Calculation of space requirements

   a. Heating for each area of the facility is commonly provided by an oil-fired hot-water boiler located in the mechanical equipment room. During the heating season, hot water is supplied from the boiler to the various heating, air-conditioning, and domestic hot-water systems. In the summer, domestic hot water is provided by a small oil-fired hot-water heater and the boiler is turned off. This arrangement will add to boiler efficiency and energy conservation.

   b. Provisions will be made in the mechanical equipment rooms to allow for removal of tubes from boilers and chillers as well as the removal of coils and filters from air handling units for maintenance and replacement. All equipment will be located to allow easy access for maintenance and servicing.

   c. Usage will be 24 hours per day, 7 days per week. No special provisions for peak usage are required.

activities

1. Maintaining, controlling, and inspecting mechanical equipment.

personnel

equipment*

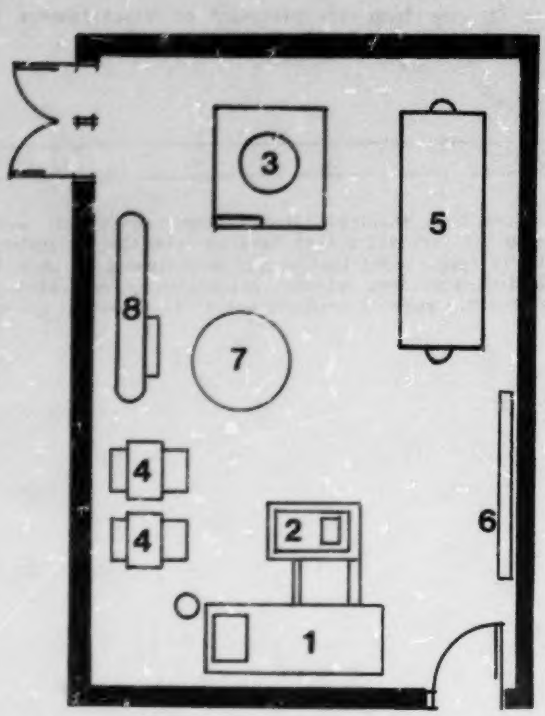
1. Chiller.
2. Condenser.
3. Compressor.
4. Water pumps.
5. Boiler.
6. Electrical switchboard.
7. Emergency water supply tank.
8. Day fuel tank.
9. Emergency fuel storage tank. (Underground--see Vol 2, SB8.)

Note: Alternative energy sources may vary and alter equipment needs. See Vol 2, SB6--AES, for information.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate the mechanical equipment requirements associated with the facility's environmental maintenance.	**1.** The ratio of mechanical equipment space to the total facility interior floor space varies from 7 percent for small facilities to about 4 percent for large facilities. (See "Issues" box.)	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation for variable noise levels produced by mechanical equipment.	**3.** Adjacent room walls should limit sound transmission to 40 decibels.	
4. Information display.	**4.** The operating instructions, preventive maintenance schedule, wiring and control diagrams, and detailed control sequence should be framed under glass or plastic and posted for easy reference.	
5. Water supply and sanitary sewer.	**5.** The water supply and sanitary sewer for this facility will be connected to the existing post systems or as prescribed for foreign locations. Provide an emergency water supply tank of 20-gallon per capita capacity for 7 days. Water must be refreshed periodically. See Vol 2, SB8, Survivability Protection.	
6. Adequate lighting.	**6.** Provide 40-footcandle fluorescent fixtures (ambient).	
7. Thermal comfort.	**7.** 50 to 68°F range (winter heating), except for batteries, which must be kept at 60 to 68°F.	**7.** See also Vol 2, SB2--Communication Station Buildings--Mechanical.
8. Electrical power.	**8.** Commercial electrical service used in the building will be site-specific. Availability depends on the host country if OCONUS. An outdoor transformer can be installed for the mechanical space in terms of general building power. Install 120-volt receptacles as needed. Electrical power must fall within the 10,000- to 500,000-watt range. Frequency levels should be at 50 to 60 hertz ± 5 percent.	**8.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
9. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**9.** Interior enclosure walls--1-hour fire-rated construction. Interior doors--20-minute fire-rated. Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**9.** See Standardized Modules--Building Design Principles, Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



9-- underground emergency fuel storage tank outside building.

guidance

1. Storage tank

A single storage tank should be provided for a minimum 15-day supply for both the heating boiler and diesel engine generators. A fiberglass underground tank should be used. A day tank should be provided in the building to supply fuel to both the heating boiler and diesel engine generators. This tank must be equipped with a float switch to activate an alarm indicating a low fuel oil condition.

Doors--The exterior equipment doors should be steel, double swing type with steel frame. The inner opening should be at minimum 6 feet wide by 7 feet high. The equipment door should be equipped with interior locking panic hardware.

Both the exterior personnel and equipment door hinges must be welded to prevent removal of hinge pins if pivots and pins are on the outside.

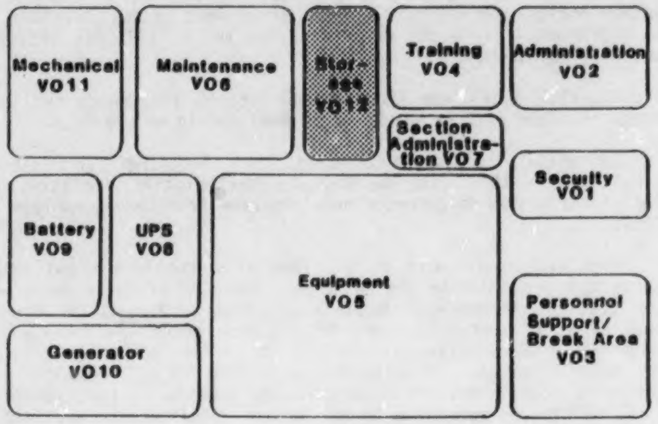
Provide security bars on all openings greater than 7.6 feet at the perimeter and subject to physical intrusion (for example, air intake and exhaust louvers). Their attachment to the structure must be nonremovable from the exterior. See Vol 2, SB7, for additional security guidance.

Structural--The minimum floor design load is 150 pounds per square foot. A clear ceiling height of 10 feet should be provided.

Mechanical equipment should be isolated to minimize vibrations. This can be done by mechanically isolating each individual system on concrete pads separate from the mechanical room floor.

Heat exchangers must be provided with air intake and exhaust ducts to the outside of the building. The size of these ducts means the heat exchangers must be located close to the wall. However, some types of heat exchangers require rear access for maintenance. Location of dehydration pressurization equipment is not critical, but ease of access for maintenance is desirable. Pressure gages should be readily visible to maintenance personnel. Location of the air-conditioning equipment depends on the specific type provided and whether intake and exhaust to the building's outside are required. (2) 5-25

STORAGE VO12


Mechanical VO11
Maintenance VO6
Storage VO12
Training VO4
Administration VO2
Section Administration VO7
Security VO1
Battery VO9
UPS VO8
Equipment VO5
Generator VO10
Personnel Support/ Break Area VO3

function

This area is for the temporary placement of miscellaneous items and nontechnical equipment.

policy/sop

1. All services have physical fitness requirements that must be met. For remote DCS facilities that have no installation services available, it is recommended that exercise equipment be made available. The exacting, sometimes intense, activities of maintaining and controlling the DCS require periodic breaks for physical exercises.

issues and assumptions

1. Storage for exercise equipment

The exercise equipment should not conflict with the function of other personnel-oriented rooms. A general purpose storage room is suitable since the equipment is unofficial.

activities

1. Shelving of miscellaneous sized items.
2. Individual exercise.

personnel

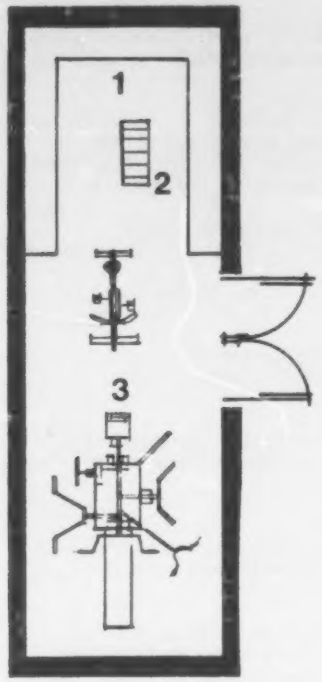
equipment *

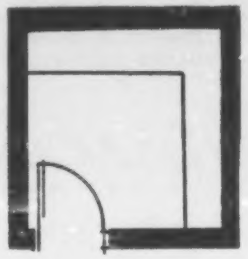
1. Shelving 18 inches deep.
2. Small step ladder.
3. Exercycle, universal gym, and/or loose weights.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate two or three persons exercising, plus space to move about for shelving items.	**1.** Allow approximately 250 square feet to accommodate the exercise equipment plus 60 linear feet of shelf space.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	**3.** Adjacent room walls should limit sound transmission to 40 decibels.	
4. Adequate lighting.	**4.** Use 30-footcandle (ambient) fluorescent fixtures.	
5. Thermal comfort.	**5.** Regulate temperature at 68°F (heating), 78°F (cooling). Provide 10 cubic feet per minute per person outside air ventilation rate with on-off switching.	**5.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
6. Electrical power.	**6.** Install 120/208 electrical service. Provide 120-volt outlets--one receptacle for every 10 linear feet of wall. Frequency levels should be at 50 to 60 hertz ± 5 percent.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

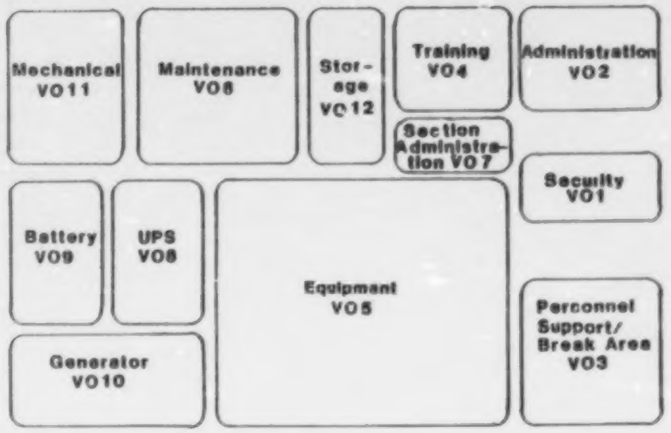
guidance





guidance

STANDARDIZED MODULES VO13



building design principles

1. Efficiency of operational functions
    a. Communication equipment aligned for surveillance and access.
    b. On-the-job training with operating equipment.

2. Integration of parts/maintenance modules with operations
    a. Parts/maintenance modules contiguous with operations spaces.
    b. Loading dock accessibility for equipment and supplies.

3. Efficiency and accessibility of administration spaces
    a. Administration transition space between public areas and secure spaces.
    b. Efficiency of integrated administrative spaces.

4. Personnel support spaces
    a. Change of environment for on-duty personnel.
    b. Facilities available for physical training.

5. Integration of power/UPS modules
    a. Economies and efficiencies of integrated power modules.
    b. Minimized impact of generators on communications transmissions.

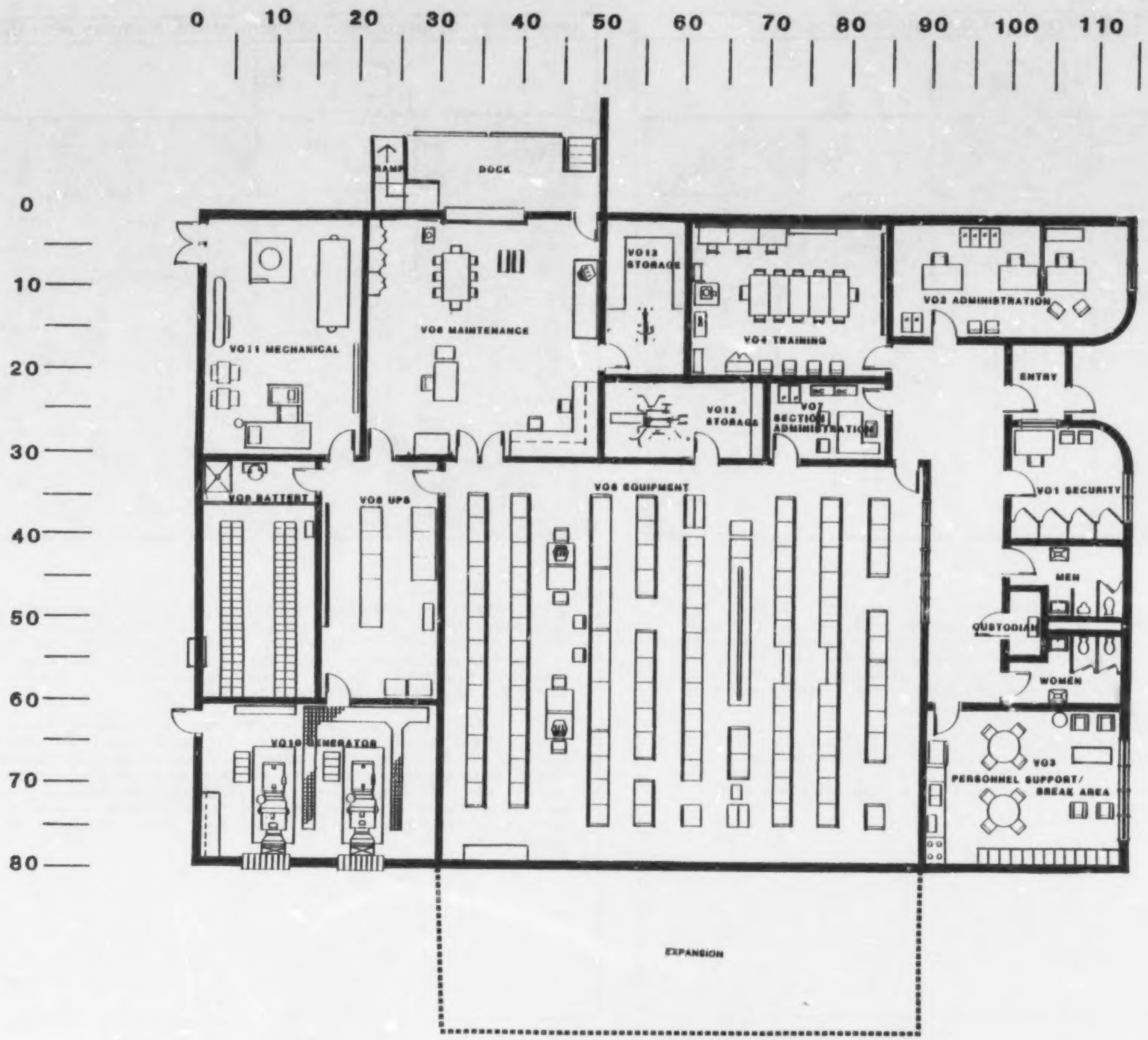
6. Facility expansion
    a. Expansion potential in new construction operations space.
    b. Minimized impact of future operations space expansion.

7. Security operation
    a. Location of security space to control building access.
    b. Central monitoring of total site and building security.
    c. Message security in operations and cryptography modules.
    d. Limited access into secure areas.

8. Facility security/survivability
    a. Required vault construction for communication system equipment.

9. Fire protection
    a. Fire protection classifications: occupancy, hazard of contents, sprinkler protection, and construction/materials.
    b. Building separation distances.
    c. Fire protection systems: automatic fire suppression, automatic notification/alarm, and automatic fire detection.

10. Life Safety
    a. Occupant load determination.
    b. Protected exit conditions: exit capacities, number of exits, exit travel distances, and means of exit arrangement.
    c. Allowable interior finishes.
    d. Egress path identification: illumination of means of egress, emergency lighting, and means of egress marking.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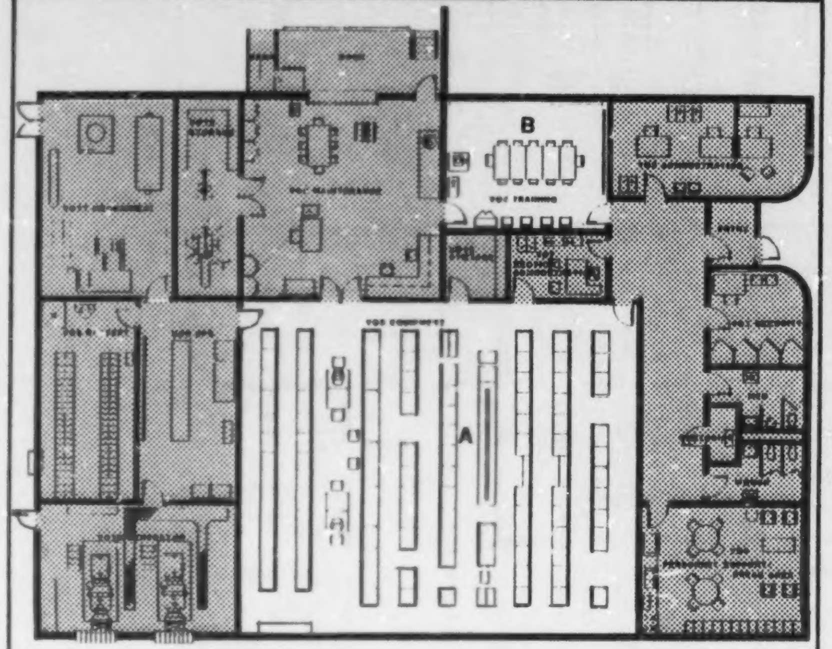
RAMP
DOCK
VO11 MECHANICAL
VO6 MAINTENANCE
VO12 STORAGE
VO4 TRAINING
VO2 ADMINISTRATION
ENTRY
VO12 STORAGE
VO7 SECTION ADMINISTRATION
VO9 BATTERY
VO8 UPS
VO5 EQUIPMENT
VO1 SECURITY
MEN
CUSTODIAN
WOMEN
VO10 GENERATOR
VO3 PERSONNEL SUPPORT/ BREAK AREA
EXPANSION

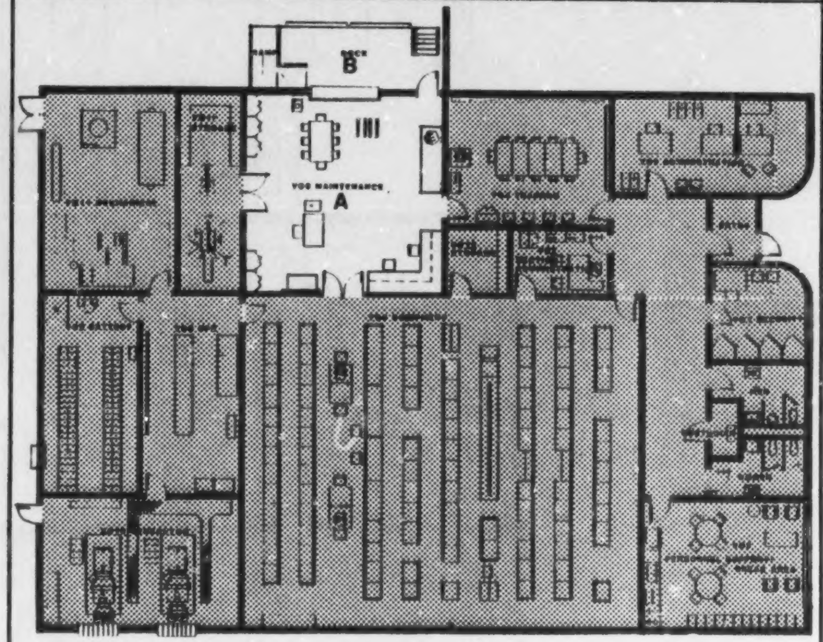
guidance 1. Efficiency of Operational Functions



A. Equipment should be aligned in parallel rows within the Operations modules for ease in visual surveillance and to provide direct access to all critical equipment. Multiple consoles should be adjacent to each other so that limited personnel may efficiently monitor them at one central location. Tables for AV training aids should be available in Operations modules so that personnel can train "on-the-job" during regular watch periods.

B. To further enhance the effectiveness of personnel training while "on-the-job", instruction may occur in small groups of 4 or 5 in a Training room for hands-on training working with the communications equipment, thus requiring a close relationship to the Operations module.

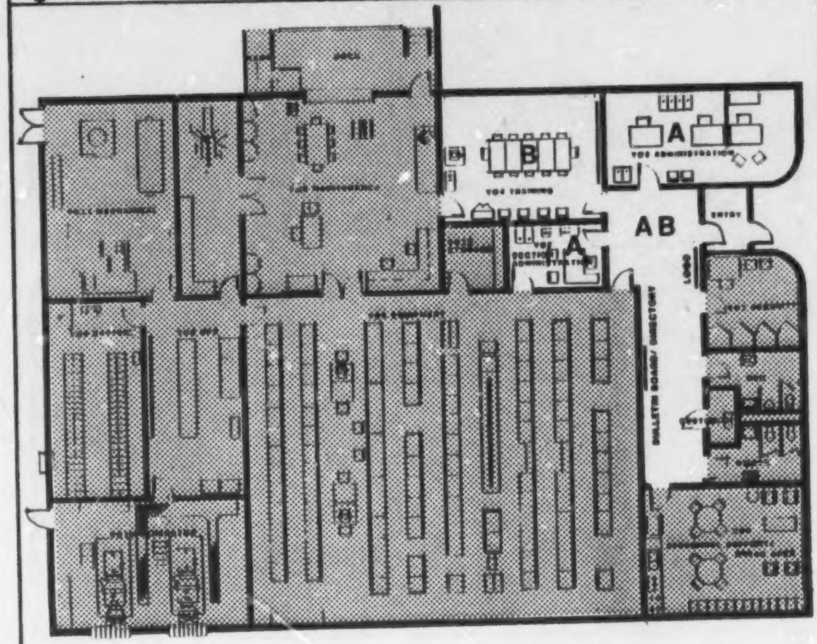
guidance 2. Integration of Parts/Maint. Modules with Ops.



A. Parts and maintenance modules should be well integrated and contiguous to the operations spaces to optimize efficiency and minimize circulation. The secure door between the operations and the maintenance/parts spaces is only used as a fire exit and to bring communication equipment in and out via the loading dock. This door should have opening hardware only on the secure side.

B. Maintenance and Parts modules must be located within an organizational context such that deliveries can be made to the total building in a direct and secure manner at a loading dock. The large communication equipment can be more easily moved in and out using the loading dock. (Also, in multistory communication buildings, an elevator should be located adjacent to the Parts module in order to safely move large communication equipment vertically throughout the building.)

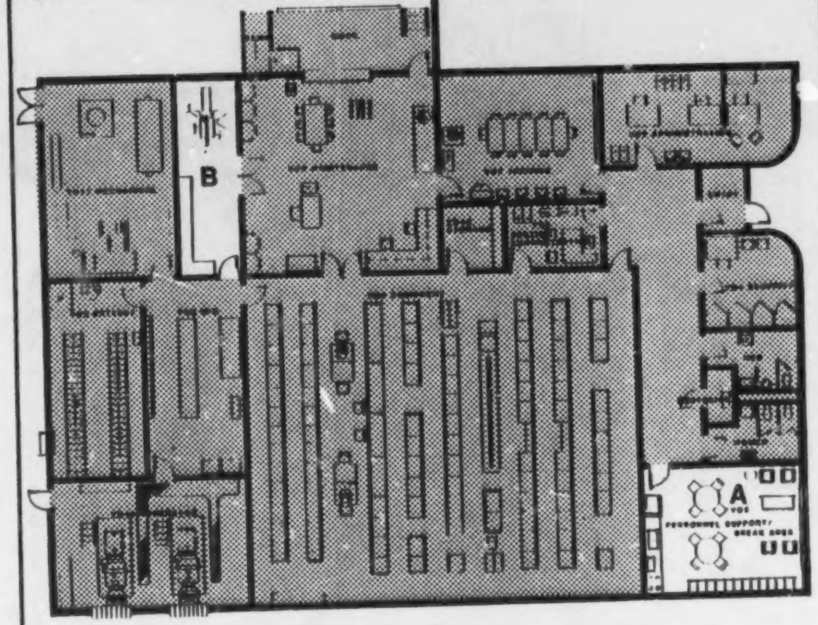
guidance 3. Efficiency and Accessibility of Admin. Spaces



A. Administration modules must be easily accessible to the public to minimize circulation and to prevent visitor interference with facility operations. The Administration modules should provide a buffer and transition space between the exterior and interior secure spaces. Also, public corridors in the administrative area should contain military unit logos and other display panels that relate to the esprit de corps and unit integrity of the communication station.

B. Integrated relationship of Administration spaces will improve efficiency by minimizing public and administrative circulation, and by producing a group adjacency to shared conference areas, secretaries and waiting areas.

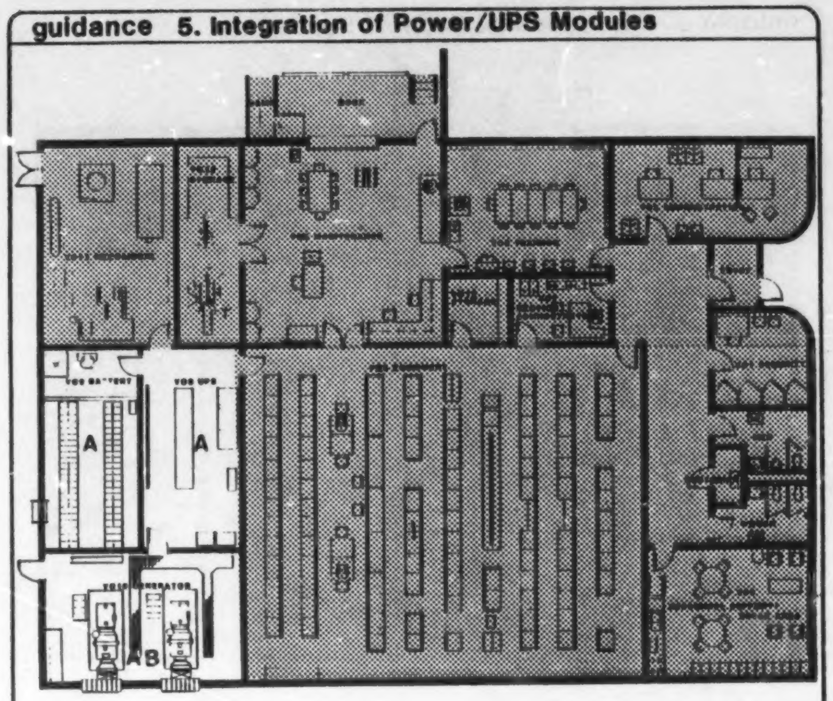
guidance 4. Personnel Support Spaces



A. The intense activities within the DCS facility tend to generate personnel mental fatigue. It is necessary therefore to create a change of environment for on-duty personnel in order to provide a break from the "hard surface" equipment room and work areas. The Personnel Support module should be directly adjacent to the Operations Room, but isolated acoustically and visually.

B. The additional provision of physical exercise equipment for those DCS facilities located off Military bases is recommended. The necessary showers and lockers should be similarly adjacent to the Operations module for easy accessibility and optimum use.

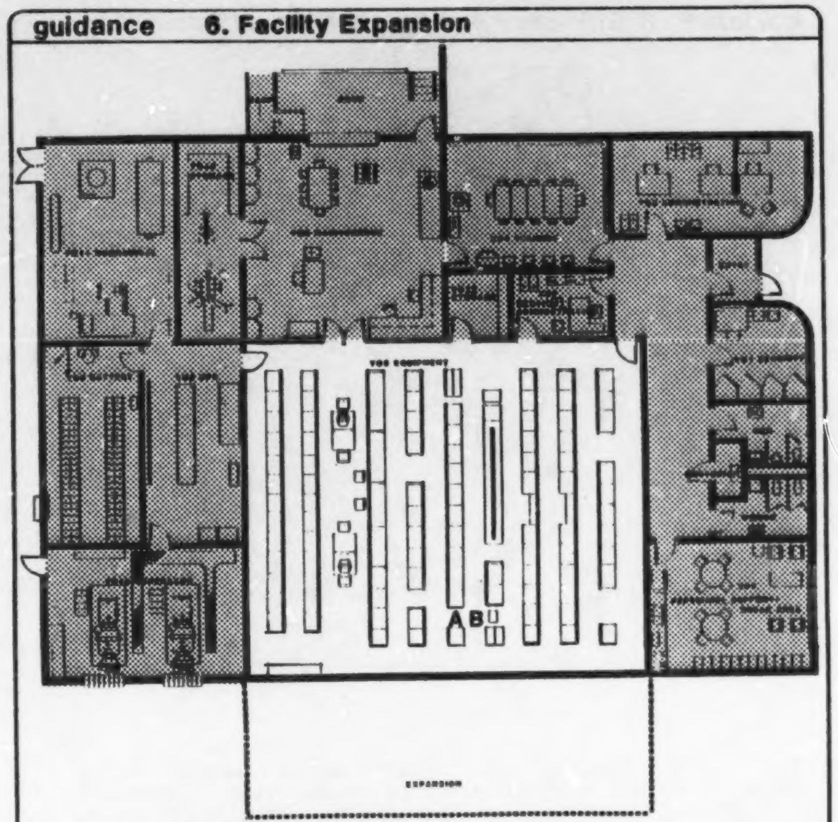
guidance 5. Integration of Power/UPS Modules



A. Modules that comprise the power and UPS gear should be contiguous and well integrated together. Direct physical adjacencies will provide economy by minimizing cable lengths and produce personnel efficiency resulting from inter-access relationships.

B. Confining the power and UPS spaces to remote area will minimize the impact of generator vibrations that may adversely affect the communications transmissions.

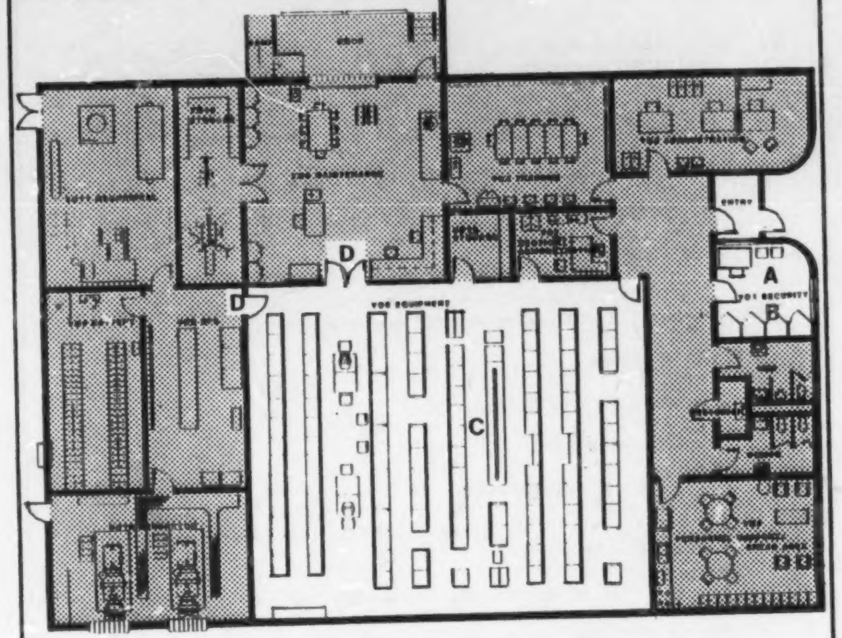
guidance 6. Facility Expansion



A. The equipment layout should be planned in such a manner as to afford sufficient space for the installation of equipment capable of handling the maximum projected traffic load. The initial equipment layout should be such that ultimate expansion of the station facility can be accomplished without extensively rearranging already installed equipment. Allowance of space for future equipment can be determined if specific equipments for future installation are known; otherwise, an estimate based upon the requirements of similar equipments should be made. In a new communications facility, a 100% equipment expansion is reasonable.

B. Operations modules should be functionally isolated from support and power modules. Due to the increasingly rapid changes in the technology of communications, new demands on the spatial layout of Operations modules can be expected in the future. Such spaces must have the capability to expand to accommodate new equipment and new functions. It is not anticipated that support and power spaces will need this same expansion capability and therefore may be located in their own areas; i.e., facility design should allow Operations modules to expand without significantly affecting the remaining functions.

guidance 7. Security Operation



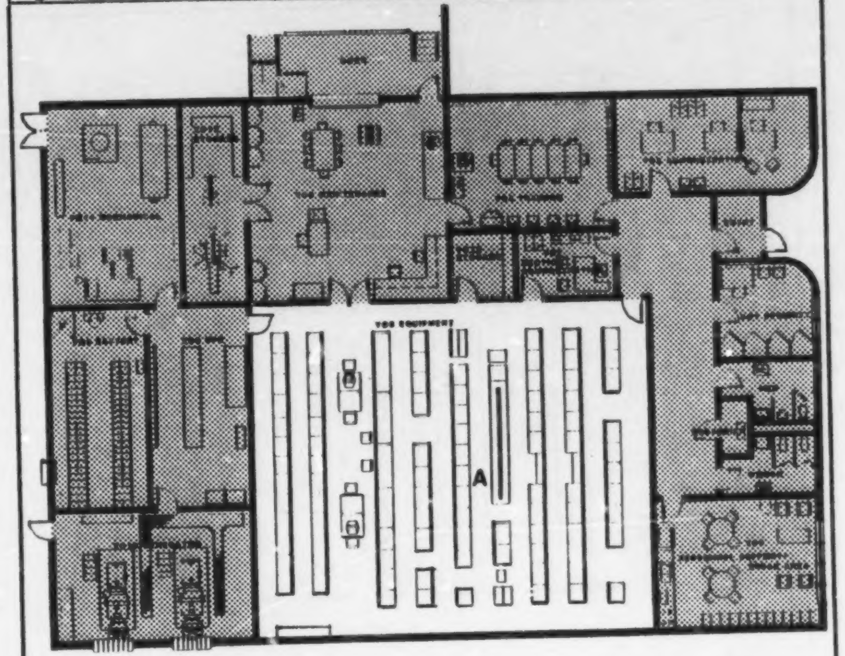
A. Security modules should be located to provide overview for entry verification of visiting personnel. Additionally this module must be easily accessible to building occupants to facilitate the efficient storage and distribution of personnel weapons.

B. The Security module will administrate site security, monitor all intrusion detection systems, and initiate appropriate reactions to hostile threats. The Security module should therefore be designed to provide overview and control over site access and all exterior activities.

C. "Message" security is accomplished by minimizing circulation between operations and cryptography modules, confining the modules to controlled areas, and by providing disposal techniques performed or controlled by appropriate personnel.

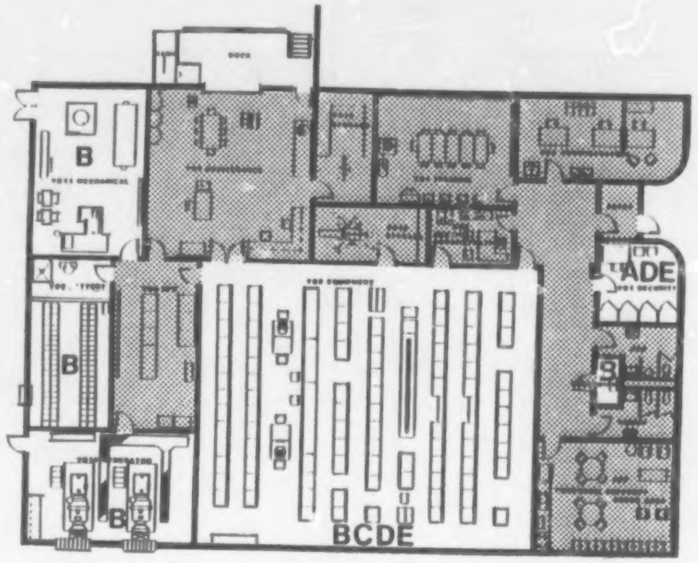
D. Required doors from other interior modules (or from the outside) that open into secure areas should have opening hardware only on the secure side.

guidance 8. Facility Security/Survivability



A. Conventional Class A vault construction is required for all those spaces containing the communication system equipment; such as Operations, Equipment and Tech Control. Therefore efficient construction methods and future building flexibility requirements can be met by locating these spaces in a contiguous relationship. These spaces usually require the vault-type construction for a combination of four requirements: 1) HEMP protection, ·2) TEMPEST shielding, 3) building intrusion resistance and 4) fire protection. (See SB-7 Security Systems--guidance for building security construction of Zone 4, Section 5b).

guidance 9. Fire Protection



Occupancy classifications: Business (NFPA); B-2 (UBC)

Hazard of contents classification: Ordinary hazard

Sprinkler protection classification: Ordinary hazard--group 2.

Construction classifications/materials for fire protection (See Vol 2, the first figure in SB3, Fire Protection/Life Safety)

A. Type II--fire resistive (UBC) for security/armory spaces:

Construction Element	
Exterior walls	4-hour rated construction
Interior bearing walls	2-hour rated construction
Structural frame	2-hour rated construction
Permanent partitions	1-hour rated construction
Shaft enclosures	2-hour rated construction
Floors	2-hour rated construction
Roofs	2-hour rated construction

B. Type II--One-Hour (UBC) for battery, cryptography (RED/BLACK),* custodian, generator, operations,* mechanical, and transmission spaces:

All construction elements.......1-hour rated construction

Type II--N (UBC) for remainder of building spaces

All construction elements.......Noncombustible construction

Building Separation

Site-specific information is required. Comply with the second figure in Vol 2, SB3, Fire Protection/Life Safety.

Interior finishes

See Guidance/Life Safety, Vol 2.

Fire protection systems

Automatic fire suppression

A water sprinkler system shall be provided throughout the entire facility.

C. A Halon 1301 or carbon dioxide system shall be provided under raised floor areas containing nonmetallic, sheathed, exposed cables when the space under the raised floor is used as an air plenum.

Automatic notification/alarm

A general alarm must be activated by the automatic sprinkler system.

D. Local alarms are required to sound only in the designated spaces; they are activated by smoke detectors.

Automatic fire detection

E. Smoke detectors are required to activate local alarms only in the designated spaces. In rooms containing raised floor areas, smoke detectors shall be located under the raised floor.

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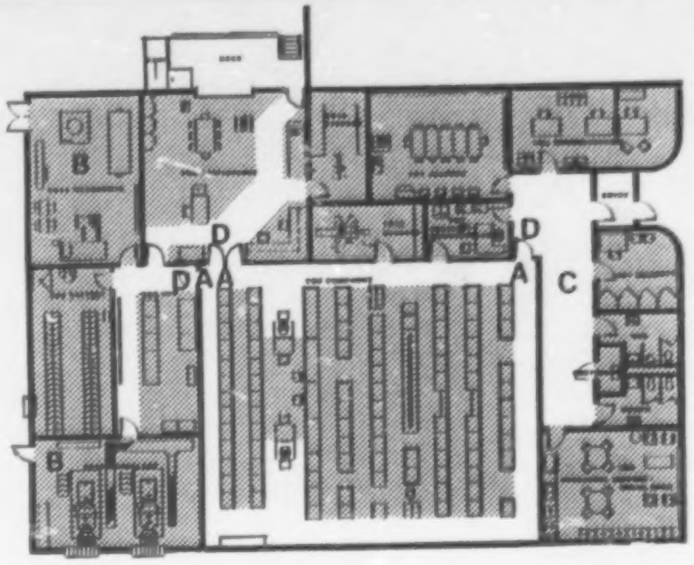
*See Vol 2, SB7, Security, for vault construction requirements that may be more stringent than those imposed by fire protection requirements.



OCCUPANT LOAD: (For determining exit requirements)

Occupant Load Factor: 100 sq ft/person based on gross floor area (Business Occupancy-NFPA)

Occupant Load= (total Facility) $\frac{9{,}165 \text{ sq ft}}{100}$ = 92 persons

Occupant Load= (vaulted area) $\frac{3{,}000 \text{ sq ft}}{100}$ = 30 persons

Occupant Load= (admin/support) $\frac{2{,}765 \text{ sq ft}}{100}$ = 28 persons

Exit capacities

Corridors--100 persons per unit of exit width for travel in either direction. The minimum width of any exit access corridor or passageway shall be 44 inches in the clear.

Doors--100 persons per unit of exit width (a 3-foot door provides 1.5 units of exit width, providing an exit capacity for 150 persons).

Number of exits

No less than two exits shall be accessible from every part of every floor. One exit is permitted when the room or area has: (1) a total occupant load of less than 100 persons, (2) direct exit to an open area outside the building at the ground level, and (3) a total travel distance on the same level of not over 100 feet. (If stairs are involved, they shall be no more than 15 feet in height and shall be provided with complete enclosures to separate the stairs from any other part of the building.)

Exit travel distances

Required exits shall be located to allow access without passage through areas that may be locked. No dead end corridor shall exceed 50 feet. Travel distance to exits shall be no more than 300 feet when the building is protected throughout by an approved automatic sprinkler system.

Arrangement of means of egress

Exit access and travel routes to exits are shown in the plan.

A. Exit doors in vaulted areas that contain communications equipment are secured and permit egress out only. Exit access routes through vaulted areas from spaces outside the vaulted area are not permitted for security reasons.

B. Two means of egress shall be provided from higher hazard areas, including mechanical and generator spaces. Exit access from any other space may not pass through the mechanical or generator spaces (see exit marking). For security, when mechanical or generator spaces have exit access routes through interior spaces, exit access doors from these spaces, when opened, shall sound an alarm and transmit a signal to the annunciator panel in the security space. Access for normal maintenance in mechanical and generator spaces shall be through the exterior doors.

guidance

Interior finishes

C. Interior finish in exit access corridors shall be Class A only.

Interior finish in the remainder of the building shall be Class A or B only.

Means of egress lighting

Exits and exit access, including stairs, aisles, corridors, and passageways leading to an exit, shall be lighted continuously during times when the conditions of occupancy require means of egress to be available. Lighting should be no less than 1 footcandle measured at the floor.

Emergency lighting

Emergency lighting shall be provided in windowless buildings for designated aisles, corridors, and passageways leading to an exit. Emergency lighting shall stay at least 1 footcandle throughout the means of egress for 1.5 hours in the event of normal lighting failure.

Marking the means of egress

Exits shall be marked by an approved sign readily visible from any direction of exit access. Signs shall be placed such that no point in the exit access is more than 100 feet from the nearest visible sign.

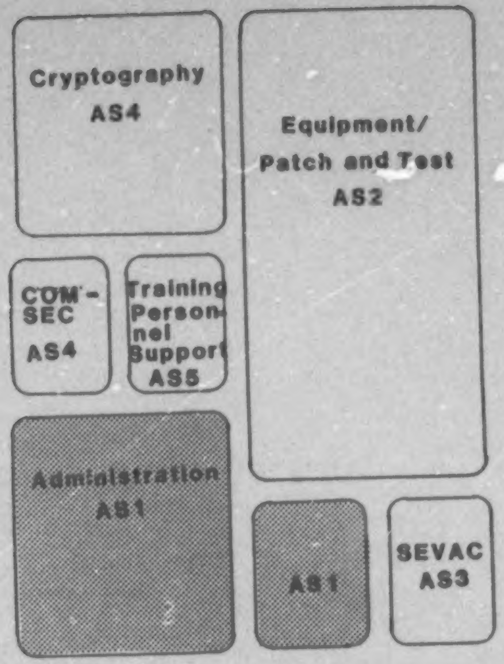
D. Doors located or arranged so that they are likely to be mistaken for exits shall be identified by a sign reading "NOT AN EXIT."

guidance

Voice-AUTOSEVOCOM/ALCEP [AS]

Voice-AUTOSEVOCOM (AS) AS-1
AS1 Administration AS-2
AS2 Equipment/Patch and Test AS-6
AS3 SEVAC AS-12
AS4 Cryptography/COMSEC AS-18
AS5 Training/Personnel Support AS-24

ADMINISTRATION AS1


Cryptography
AS4
Equipment/
Patch and Test
AS2
COM-
SEC
AS4
Training
Person-
nel
Support
AS5
Administration
AS1
AS1
SEVAC
AS3

function

To establish and maintain the station administrative processing of personnel records and to implement written and verbal SOP directives from chain of command orders, host agency regulations, and DCA policy for DCS. The administration area provides a buffer and transition space between exterior and secure interior spaces. The administrative function is to provide the quality control and equipment management service for the Autosevocom/Alcep facilities.

policy/sop

1. The administration module supports the "AS" facility as a clearing house for:
    - a. Quality control
    - b. Equipment management:
        - 1. Equipment malfunction action: send out for major repair or replacement
        - 2. Equipment testing action: make minor repairs in-house
    - c. Updating manuals
    - d. Facility administration (a through c above).

issues and assumptions

1. Automation of administrative information

The use of a minicomputer with CRT and printout capability will streamline the administrative function. Software programs are needed for:

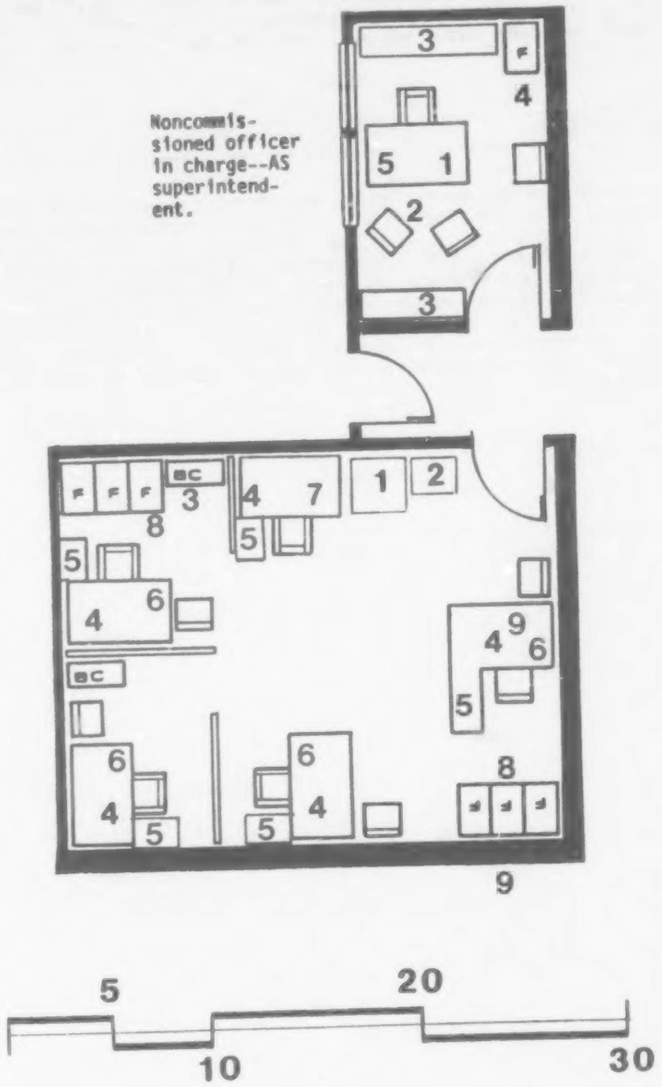
- a. Master station--trunk history
- b. Circuit layout records
- c. Automatic analysis thresholds (total time and number)
- d. Trouble tickets
- e. 551 Report (DCA reporting system)
- f. Training and scheduling
- g. Quality assurance information:
  - 1. Equipment (what is due for checkup?)
  - 2. Tasks (what has to be done?)

activities	personnel	equipment *
1. Providing quality control (QC). 2. Analyzing communication equipment. 3. Testing communication equipment. 4. Developing personnel training plans and equipment evaluations.	1. Operations noncommissioned officer (NCO). 2. Systems NCO. 3. Circuit actions NCO. 4. QC NCO. 5. Training NCO.	**1.** Test equipment. **2.** Test tools. **3.** Shelving for training manuals. **4.** Five desks with chairs. **5.** Five typewriters with stands. **6.** Telephones. **7.** CRT with printout capability. **8.** Files. **9.** Operational voice intercom control.
1. Supervising administration group. a. Distributing directives, orders, and policy statements, both written and verbal, to shift supervisors. b. Initiating evaluations of equipment capabilities.	1. Noncommissioned officer in charge--AS superintendent.	**1.** Desk with chair (enclosed). **2.** Three side chairs. **3.** Twelve-linear-foot bookcase. **4.** File cabinet. **5.** Typewriter/word processor.

* See "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the administrative function.	**1.** Provide administrative space for supervisory personnel. This area varies with the number of assigned personnel, but is typically 700 to 800 square feet.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Carpet. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	**3.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**3.** See reference 201, page 3-4, Table 3-2.
4. Adequate lighting.	**4.** Provide 80 footcandles for task lighting at work surfaces with 40 footcandles for the ambient level. Surface reflectances should be: • Ceilings--80 to 90 percent • Walls--40 to 60 percent • Floor--20 to 40 percent.	**4.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for the occupant.	**5.** Maintain temperature at 68°F (heating), 78°F (cooling), with 5 cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	
6. Electrical power.	**6.** Provide 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppresion--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunicator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location

Windows to the outside are recommended for CONUS facilities on secure sites, such as military installations. OCONUS facilities usually should have a minimum of windows to limit opportunities for forced entry.

Activity subspaces

- Enclosed offices
- Workstations
- Filing area
- Reception.

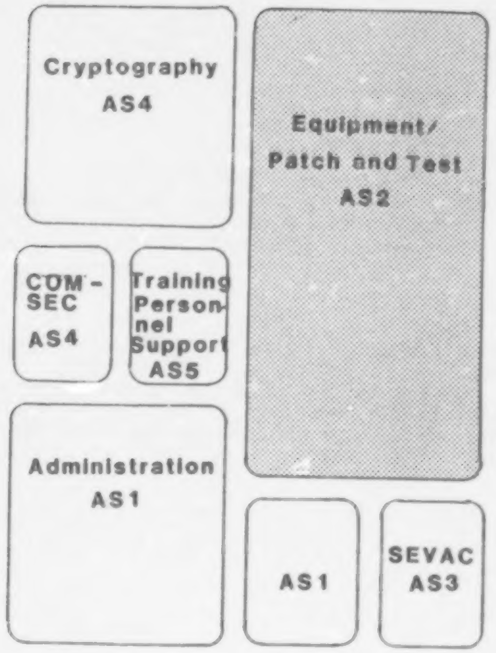
3. Acoustical and visual privacy

Divider partitions between workstations should be 60 inches high (± 4 inches) to provide visual privacy while occupants are seated--and yet should not be confining. Circulation paths around workstations should minimize disturbances to other workstations.

Electrical power

Workstation divider partitions can be tackboard surfaces to display maps, job examples, service equipment, and other information. Floor-to-ceiling poles are recommended to distribute electrical and communication lines to workstation modules. This eliminates floor wires at circulation paths and allows future module modifications at minimal cost.

EQUIPMENT/PATCH AND TEST AS2


Cryptography
AS4
Equipment/
Patch and Test
AS2
COM-SEC
AS4
Training
Person-nel
Support
AS5
Administration
AS1
AS1
SEVAC
AS3

function

To house the electronic communication equipment and provide for assigned personnel who repair, clean, and test the equipment. "Patch and test" refers to the monitoring of communications in order to provide continuous operation with minimum loss of service and no loss of traffic.

policy/sop

1. Equipment and equipment layout should be standardized as much as possible among the facilities comprising a communications system. In determining the layout for situations in which unencrypted signals bearing classified information are present or processed, the specialized installation guidance in MIL-HDBK-232(C) must be consulted. Another major consideration should be necessary access for installation, maintenance, and operation. This would include considerations such as provision of adequate space between equipment rows for open cabinet doors or slide-out modules for maintenance. (2) 5-20

issues and assumptions

1. Automated recordkeeping

CRTs with hardline printers can streamline paperwork by having all circuit history files on disk, eliminating time-consuming paperwork. This will allow troubleshooting to be done much more rapidly in-house.

2. Electromagnetic compatibilty (2) 5-43

Electromagnetic compatibility (EMC) is a complex subject with specialists often needed to perform an EMC study to insure that the equipment layout produces no interferences or radiation hazard.

New regulations from DOD control permissible levels of electromagnetic pollution of the frequency spectrum due to the concern for environmental protection. Radiation also is being regulated through concern for occupational safety. Engineering agencies hired for DOD work must understand the legal and regulatory aspects of EMC and radiation hazard to meet these requirements.

Military specifications on EMC, such as MIL-STD-461, 462, and 463, are intended to control and achieve an acceptable figure of merit or quality in the development of new communications equipment. They do not eliminate the need for EMC engineering in facility design. In addition to equipment quality, frequency selection, nearness to other facilities and, to some extent, the facility design itself are variables in the interference generation problems. (2) 5-43

3. Determining the correct shielding procedure

A comprehensive approach to shielding equipment from radio frequency interference (RFI) or TEMPEST involves (a) a building layout to optimize inherent facility shielding conditions, (b) appropriate location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components.

See SB4 of Volume 2 for additional guidance.

activities

1. Receiving and processing outage reports.
2. Monitoring and maintaining electronic communication equipment.
3. Performing patch and test exercises.
4. Testing switch equipment.
5. Typing report logs.
6. Maintaining records on parts and equipment.

personnel

1. Shift supervisor.
2. Two operators.

equipment *

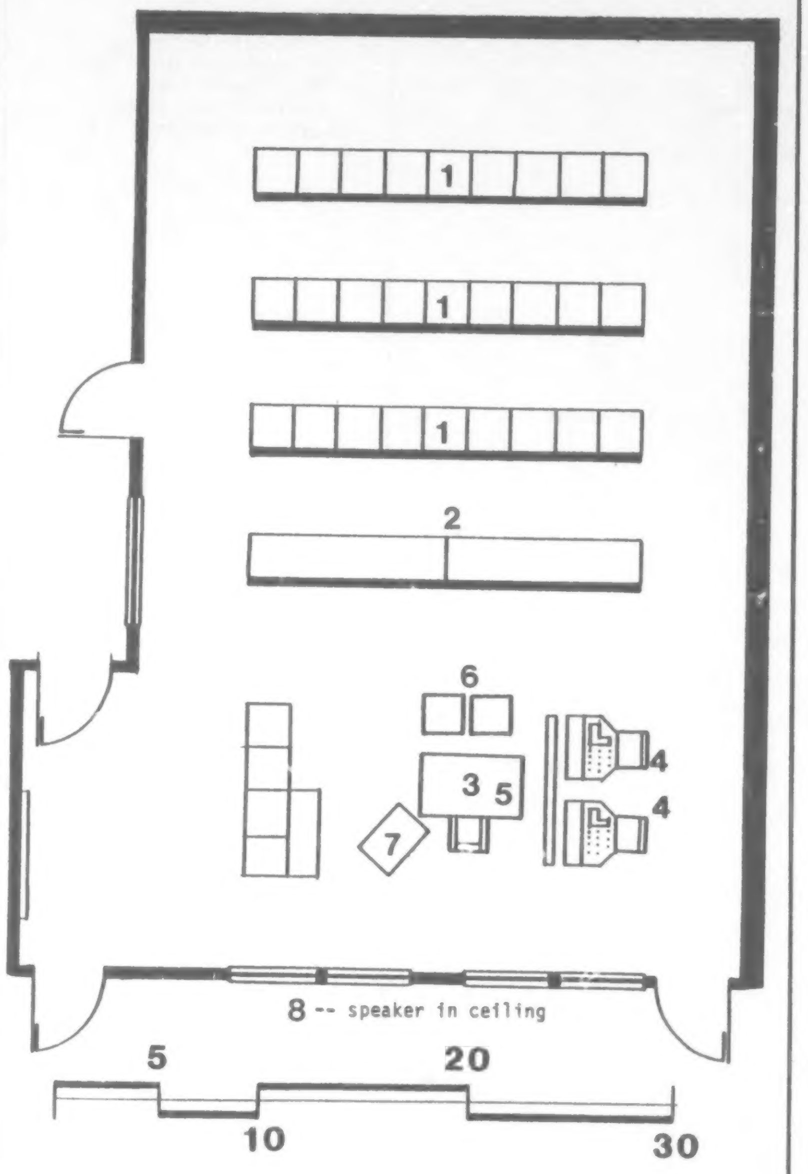
1. Thirty-one switch and modem/CRYPTO racks (see Guidance).
2. Patch and test bay.
3. Console desk with chair.
4. Two printers.
5. Telephones.
6. Two file safes.
7. Typewriter with stand.
8. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate the patch panels, console, and printer. Space also must be available for the equipment and furniture associated with the supervisory function.	**1.** Varies due to extent of equipment designed. See Guidance for a typical installation.	
2. Enough space for storing, inspecting, and testing communication equipment.	**2.** A 48-inch workspace behind all equipment for inspection, testing, and repair.	
3. RFI shielding.	**3.** Electrical and electronic equipment must be shielded to prevent it from propagating interference and to protect it from the effects of interference propagated by other electrical devices. (15a) 7	**3.** See Vol 2, SB4, Grounding, Bonding and Shielding, along with SB5, EMP/HEMP Protection.
4. Raised floor system.	**4.** Raised or false floors are needed for proper cooling of the equipment.	**4.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
5. Interior finishes suitable for durability, maintenance, and room function.	**5.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor that has a dusted-on finish containing a hardener. See Vol 2, SB2, Interior Construction.	**5.** See also Vol 2, Site and Building Information, SB2, Interior Construction and Finishes.
6. Acoustical isolation/attenuation of variable noise levels produced by electrical equipment.	**6.** Adjacent rooms' walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile also is required to within 4 feet of the floor.	
7. Adequate lighting.	**7.** Ambient--20 footcandles; task--70 to 100 footcandles (testing and inspection).	
8. Environmental control for proper operation of electronic equipment.	**8.** Temperature--73°F ($\pm 2^{\circ}$); relative humidity--50 percent (±5 percent). The transmission area must have filtered air. (See MIL-HDBK-411A.)	**8.** See also Vol 2, Communication Station Buildings--Mechanical.
9. Electrical power.	**9.** Provide 120/208 electrical service. Electric power may fall within the 10,000- to 50,000-watt range. Install one 120-volt outlet for every 10 linear feet of wall and as required for coordination with equipment.	**9.** See also Vol 2, SB2, Communication Station Buildings--Electrical.

requirements	criteria	commentary
10. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**10.** Vaulted enclosure walls--2 hour (minimum) fire-rated, shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers.	**10.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

4. Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on raised floors for maximal use of coupled air directly through the cabinets. Cooling air at 60°F supplied directly into the base of the transmitters will leave the top at approximately 72°F. Thus, when the air exits the equipment, it is at a more comfortable temperature for persons working in the space.

7. Equipment area

Fixtures should be arranged above the operating aisles and should run parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so light is not obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23) 12 Portable task lighting should also be supplied for the equipment area at 70 to 100 footcandles.

8. Protection from moisture migration

Operating spaces that contain electronic equipment usually require close temperature and humidity control. Vapor barriers placed under floor slabs and roofing usually prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided if exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Inadequate cooling contributes as much to failure as poorly regulated power. (74) 4-17

Even though certain individual units can operate outside the limits of the overall specifications, overall environmental requirements are dictated by the most restrictive unit of the system. The computer system's requirements are the major considerations; however, good design will also consider personnel comfort. (74) 4-17

guidance

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in the following ways. (74) 4-17

- Heat dissipation by computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The number of air changes per hour varies between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Also, if the air-conditioning requirements are not met, a record must be available to indicate the extent and duration of the undesirable condition and indicate whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-25.

- Insure the air-conditioning system continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is needed when humidity limitations are exceeded. Drying out may be necessary if the excess humidity occurs either during periods of actual operation or while the machine is shut down and unattended. The extent and duration of excessive humidity determines the length of the drying-out period.
- Determine if the environment meets requirements for the machine.

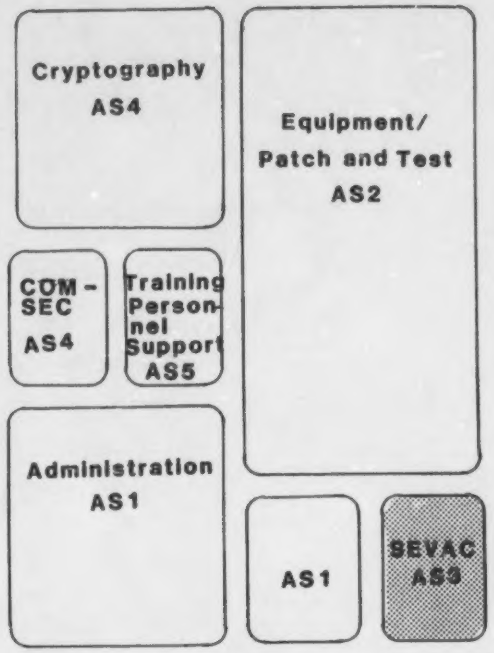
A visual or audible signaling device is desirable in the recording instrument. This is to provide visual or audible indication that temperature or humidity in the computer area is nearing the maximum limit.

guidance

Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The recorder is usually located at a representative spot in the room and adjacent to the control devices.

For monitoring underfloor air conditions, a remote indicating instrument is recommended. This is usually a 7-day electric-drive chart and can be the wet-and-dry-bulb or electronic type if direct reading is not available. The recording instrument can be located on the wall in the operations room, in the mechanical equipment room, or in any other location convenient to the building engineer.

SEVAC AS3


Cryptography
AS4
Equipment/
Patch and Test
AS2
COM-SEC
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Training
Person-nel
Support
AS5
Administration
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AS1
SEVAC
AS3

function

To monitor the SEVAC console equipment of the "31 switch."

policy/sop

1. SEVAC alarm buzzers are quite loud so, when possible, the unit should be placed in a separate, adjoining room away from the main equipment area.

best copy available

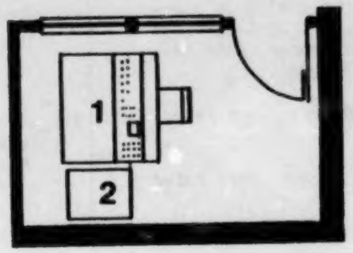
issues and assumptions	activities	personnel	equipment *
	1. Monitoring the SEVAC console.	1. One operator.	**1.** SEVAC console with chair.
			2. Side table (24 by 30 inches).

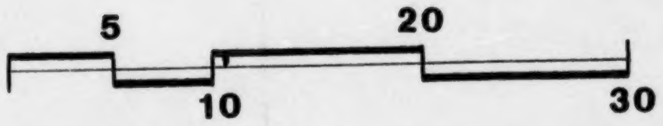
* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Adequate space for the operation and monitoring of communications-electronics (C-E) equipment. Spatial requirements must allow for proper spacing between equipment to facilitate easy maintenance.	**1.** Varies due to extent of communication equipment designed. See layout in Guidance.	
2. A secure environment for C-E equipment.	**2.** The operations room must be lockable when unstaffed and must be supplied with an intrusion alarm system. The operations console should be fitted with alarms for intrusion, power failure, and generator status. Covers should be provided on overhead rods for rapid sanitizing of applicable equipment.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Signal shielding.	**3.** See Vol 2, SB4--Grounding, Bonding and Shielding along with SB7--Security Systems for more information.	
4. EMP/HEMP shielding.	**4.** Shielding is necessary for survivability and uninterrupted functioning when the facility is subjected to EM pulse (EMP) and high-altitude EM pulse (HEMP). Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	**4.** See Vol 2, SB5, EMP/HEMP Protection, for more information.
5. Raised floor system.	**5.** Raised or false floors are necessary for proper cooling of the equipment.	**5.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
6. Interior finishes suitable for durability, maintenance, and room function.	**6.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor with a dust-on finish that contains a hardener. See Vol 2, SB2--Interior Construction. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Wall--Paint over concrete, gypsum board, or plaster and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	**6.** See also Vol 2, SB2, Interior Construction and Finishes.
7. Acoustical isolation attenuation for variable noise levels produced by electronic equipment.	**7.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile is also required to within 4 feet of the floor.	
8. Adequate lighting.	**8.** Lighting shall be specially engineered. Low levels of lighting may be required to permit observation of luminous panels without reflected glare or undesirable contrasts in brightness. Separately controlled luminaires shall be provided for normally lighted operations and for cleaning, with an ambient level of 70 footcandles from fluorescent fixtures.	**8.** For further information on quality lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.

requirements	criteria	commentary
9. Controlled environment for proper operation.	**9.** Maintain 70°F ($\pm 2^\circ$) and 50 percent relative humidity ($\pm$ 5 percent continuously. Provide 5 cubic feet per minute per person outside air ventilation rate or the outside air quantity necessary to maintain a room pressurization requirement of .05 to .10 water gage.	**9.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
10. Electrical power.	**10.** Provide 120/128 electrical service and 120-volt outlets--one receptacle for every 10 linear feet of wall. Outlets for equipment should be available under the raised floor as per layout. Electrical power must fall within the 10,000 to 500,000 watt range, with frequency levels at 50 to 60 hertz ± 5 percent.	**10.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**11.** Vaulted enclosure walls--2 hour (minimum) fire-rated, shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area--Automatic fire detection: Local alarm. Automatic Halon 1301 suppression system if required for cross-zoned or matrix detection. Sprinkler and Halon systems are not normally installed in the same areas.	**11.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance





guidance

1. Equipment expansion

It is advisable to arrange equipment in the equipment room such that future expansion of the building will not necessitate complete rearrangement. (2) 5-21

Approximately 3 feet of clearance space, as a minimum, should be allowed in front of and to the rear of an equipment bay. If a bay does not permit rear access to equipment, the bay can be installed with no clearance on the back side, that is, against a wall or back-to-back with other bays, unless ventilation requirements are compromised. (2) 5-21

5. Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on raised floors for maximal use of coupled air directly through the cabinets. Cooling air at 60°F supplied directly into the base of the transmitters will leave the top at approximately 72°F. Thus, when the air exits the equipment, it is at a more comfortable temperature for persons working in the space.

8. Control area

Light fixtures should provide an approximate uniform lighting intensity of 70 footcandles and should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. Lights over the area in which the control console is located shall be provided with wide-range (100:1) dimming control. (23)12

Equipment area

Fixtures should be arranged above the operating aisles and should run parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so light is not obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23)12 Portable task lighting should also be supplied for the equipment area at 70 to 100 footcandles.

9. Protection from moisture migration

Operating spaces that contain electronic equipment usually require close temperature, and humidity control. Vapor barriers placed under floor slabs and roofing usually prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided if exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

guidance

Mechanical

The recommended operating temperatures and humidity conditions should be obtained from the manufacturers of the communications and data processing equipment and should be used in designing the environmental control system.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Inadequate cooling contributes as much to failure as poorly regulated power. (74) 4-17

Even though certain individual units can operate outside the limits of the overall specifications, overall environmental requirements are dictated by the most restrictive unit of the system. The computer system's requirements are the major considerations; however, good design will also consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in the following ways. (74) 4-17

- Heat dissipation by computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The number of air changes per hour varies between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Also, if the air-conditioning requirements are not met, a record must be available to indicate the extent and duration of the undesirable condition and indicate whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-

guidance

- Insure the air-conditioning system continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is needed when humidity limitations are exceeded. Drying out may be necessary if the excess humidity occurs either during periods of actual operation or while the machine is shut down and unattended. The extent and duration of excessive humidity determines the length of the drying-out period.
- Determine if the environment meets requirements for the machine.

A visual or audible signaling device is desirable in the recording instrument. This is to provide visual or audible indication that temperature or humidity in the computer area is nearing the maximum limit.

Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The recorder is usually located at a representative spot in the room and adjacent to the control devices.

For monitoring underfloor air conditions, a remote indicating instrument is recommended. This is usually a 7-day electric-drive chart and can be the wet-and-dry-bulb or electronic type if direct reading is not available. The recording instrument can be located on the wall in the operations room, in the mechanical equipment room, or in any other location convenient to the building engineer.

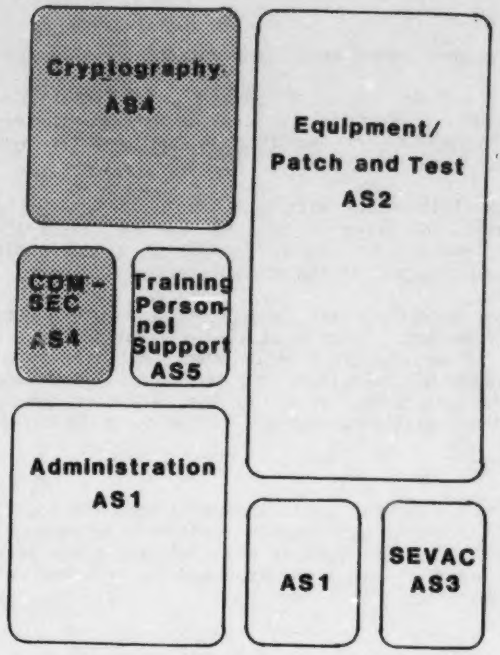
10. Electrical

Consider providing a flexible system that will meet the facility's future requirements. Electronic equipment is constantly being upgraded, modified, and replaced. Bus duct systems and cable trays may prove to be most flexible for areas in which new equipment is expected or that may have frequent modification. (5) 3-4-8

Specifically refer to the "Electrical" portion of "Issues and Assumptions" portion of SB2, Vol. 2, for information relative to host nation power requirements. Additional information may be found in "guidance" of SB2 with respect to the standard frequencies and voltage levels used by various nations.

Provide host nation standard outlets of applicable.

CRYPTOGRAPHY/COMSEC AS4


Cryptography
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function

To provide for the encryption or decryption of information passing through the communication facility. (COMSEC--communication security office.)

policy/sop

1. The national policy objective is to insure that national security information is not lost through unintentional emanations.

   See Vol 2, SB4 for additional guidance.

2. The RED/BLACK concept is the basis for the facility criteria developed here. This concept dictates that electrical and electronic circuits, components, equipment, systems, etc., that handle national security plain language information in electrical signal form (RED) be separated from those that handle encrypted or unclassified information (BLACK). Under this concept, "RED and BLACK" terminology is used to clarify specific criteria relating to the difference between these circuits, components, equipment, systems, etc., and the areas in which they are contained.

issues and assumptions

1. Determining proper location for cryptographic equipment

Locate sensitive and critical equipment as close to the core of the structure as operational requirements permit. In addition, identify the location of potential interference sources, such as power substations, engine-generators, and RF transmitters; maximize the separation between these sources and potentially susceptible equipment or systems. (15b) 1-173.

2. Electromagnetic compatibility (2) 5-43

Electromagnetic compatibility (EMC) is a complex subject, with specialists often needed to perform an EMC study to insure that the equipment and equipment layout produce no interferences or radiation hazard.

New regulations from DOD control permissible levels of electromagnetic pollution of the frequency spectrum due to the concern for environmental protection. Radiation also is being regulated through concern for occupational safety. Engineering agencies hired for DOD work must understand the legal and regulatory aspects of EMC and radiation hazard to meet these requirements.

Military specifications on EMC, such as MIL-STD-461, 462, and 463, are intended to control and achieve an acceptable figure of merit or quality in the development of new communications equipment. They do not eliminate the need for EMC engineering in facility design. In addition to equipment quality, frequency selection, nearness to other facilities and, to some extent, the facility design itself are variables in the interference generation problem. (2) 5-43

3. Determining the correct shielding procedure

A comprehensive approach to shielding equipment from radio frequency interference (RFI) or TEMPEST involves (a) a building layout to optimize inherent facility shielding conditions, (b) appropriate location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components.

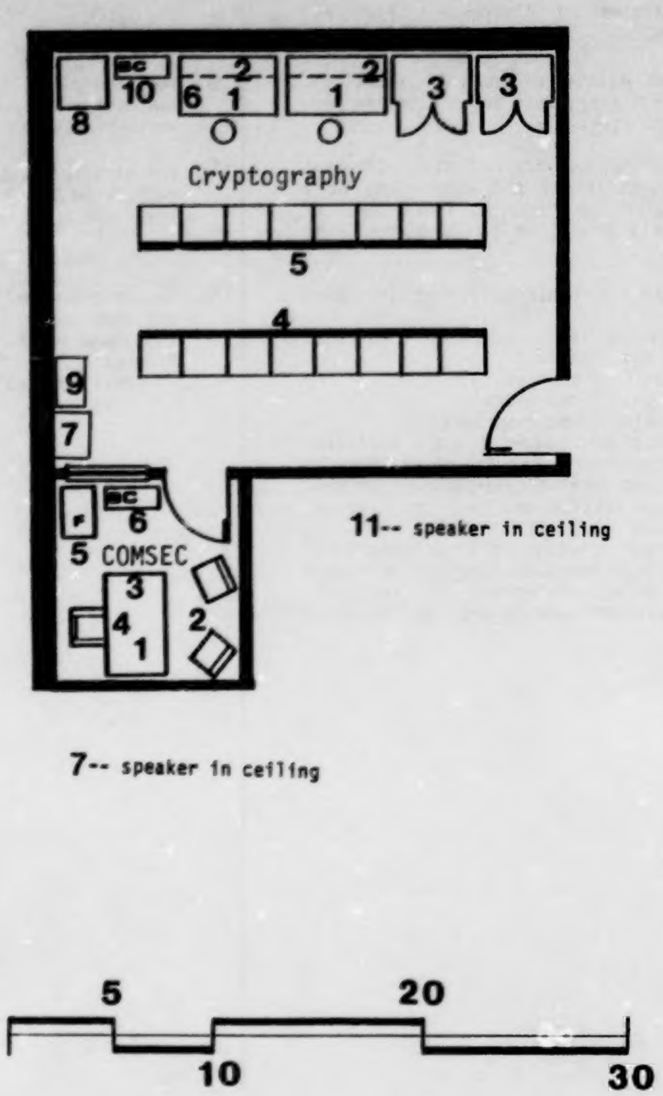
See Vol 2, SB4 for additional guidance.

activities	personnel	equipment
Cryptography 1. Inspecting and diagnosing equipment and parts. 2. Completing preventive and unscheduled maintenance. 3. Assembling electronics. 4. Testing electronics. 5. Securing storage of parts and equipment. 6. Maintaining records on parts and equipment. 7. Writing and typing reports, PMI 349s, equipment historical records. 8. Monitoring CRYPTO sync panel. 9. Notifying contractor on CRYPTO when problems arise. 10. Shredding classified and other sensitive material.	1. Two cryptography technicians.	**1.** Two electronic workbenches with stools. **2.** Shelving over workbench for publications/manuals. **3.** Locked storage cabinets for special electronic equipment secured to wall. **4.** Red Patch Bay. **5.** Black Patch Bay. **6.** Telephone. **7.** File "safe" (1) for records. **8.** Pulp shredder. **9.** Waste disposal carts. **10.** Shelving (for material to be shredded). **11.** Intercom speaker.
COMSEC 1. Administering intelligence information. 2. Writing reports. 3. Filing. 4. Briefing personnel.	1. Security officer (SSO) * see "guidance" box for example layout of all equipment listed.	**1.** Desk with chair. **2.** Chairs for visiting personnel (four). **3.** Typewriter/word processor. **4.** Telephone. **5.** One filesafe. **6.** Shelving for publications. **7.** Intercom speaker.

requirements	criteria	commentary
1. Enough space to accommodate the cryptic function.	1. Provide approximately 500 square feet for two personnel and the required cryptography equipment.	
Enough space to accommodate the shredding function.	Provide approximately 20 square feet for two personnel and a pulp shredder with waste receptacle.	
Enough space to accommodate the security officer and visiting personnel.	Provide approximately 100 square feet for a table with chairs, a desk, and two filesafes.	
2. Security.	2. Module must be lockable when unstaffed.	2. See Vol 2, SB7, Security (Zone 3), for more information.
3. Communication lines for emergency operations.	3. Coordinate the telephone system with key lines (predesignated personnel).	
4. TEMPEST shielding.	4. Electrical and electronic equipment must be shielded to prevent it from propagating interference and to protect it from the effects of interference propagated by other electronic devices. (15a) 7	4. See Vol 2, SB4, Grounding, Bonding, and Shielding, along with SB7, Security Systems, for more information.
5. EMP/HEMP shielding.	5. Shielding is necessary for survivability and uninterrupted functioning should the facility be subjected to electromagnetic pulse and high altitude electromagnetic pulse. Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	See Vol 2, SB5, EMP/HEMP Protection, for more information.
6. Interior finishes suitable for durability, maintenance, and room function.	6. Floor--Vinyl asbestos tile and wall-to-wall carpet in main traffic areas. A raised floor system shall be used over a concrete floor that has a dusted-on finish containing a hardener. See Vol 2, SB2, Interior Construction. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster, and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	6. See also Vol 2, SB2, Interior Construction and Finishes.
7. Acoustical isolation/attenuation for variable noise levels produced by electronic equipment.	7. Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), and floor surface at NRC .25 (minimum). Acoustic tile also is required to within 4 feet of the floor.	

requirements	criteria	commentary
8. Adequate lighting.	**8.** Ambient: 60 footcandles by fluorescent fixtures. Task: 100 footcandles.	
9. Thermal comfort.	**9.** Temperature should be maintained at 68°F (heating), 78°F (cooling), with a 5 cubic foot per minute per person outside ventilation rate.	**9.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
10. Electrical power.	**10.** Provide 120/208 electrical service. Install 120-volt receptacles at all workstations and workbenches at a convenient height and/or for every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ±5 percent.	**10.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumptions that this facility is windowless and houses critical equipment and data that would create a severe strategic fire loss potential.	**11.** Vaulted enclosure walls: Shielded, 2-hour (minimum) fire-rated construction. Interior doors in vaulted walls: 1½-hour fire-rated doors; shielded doors and frames. Interior finish: Class A or B only. Automatic fire detection: Local alarm. Automatic fire suppression: Water sprinklers. Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area: Automatic fire detection--local alarm. Automatic Halon 1301 suppression system if cross-zoned or matrix detection is required. Sprinkler and Halon systems usually are not installed in the same area.	**11.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance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Cryptography
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11-- speaker in ceiling
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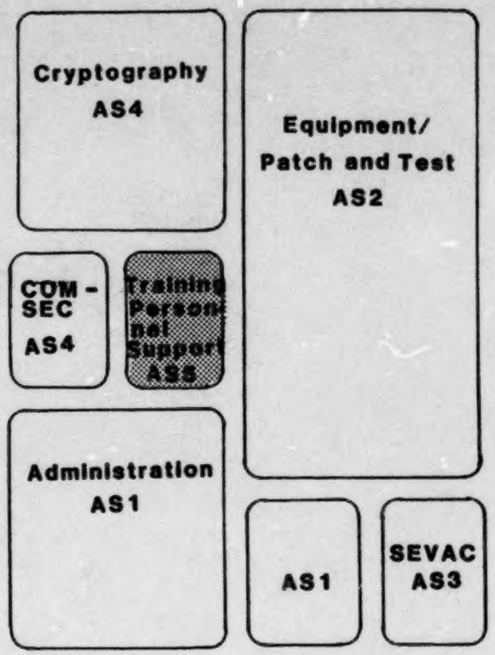
guidance

guidance

guidance

TRAINING / PERSONNEL SUPPORT AS5



function

To create a change of environment for on-duty personnel as a break from the hard surface equipment room and work areas.

To enhance personnel capability and effectiveness, both technically and personally, through the development and implementation of a station master training program.

policy/sop

Personnel support

1. The intense activities in the DCS facility generate personnel fatigue. An area separate from the communication function is needed for relaxation.
2. Current policy requires personnel to have a 15-minute break every 3 to 4 hours. Typical schedules also allow 30-minute meal breaks.
3. Most communication personnel "brown bag" their meals since they cannot leave the facility during their shift. Therefore, basic food preparation equipment is required--a kitchenette-sink, hot plate, refrigerator, cabinets, and range.

Training

1. Technical training occurs at two levels: (a) hands-on training, i.e., working directly with the communications equipment and (b) learning from manuals, publications, and audiovisual equipment. Physical training also occurs at two levels: (a) interior individual exercise and (b) exterior small group recreational activities, especially at remote DCS facilities that are not on a military installation.
2. Current policy requires personnel to be allowed time for technical training while on-duty at the facility.
3. Training usually occurs when the communication activity is at its lowest level.
4. Some communication personnel may be engaged in a CDC (Career Development Course); a training area is required for this purpose. (The Air Force has the Quick Training Package [QTP].)
5. Training usually is conducted by the shift supervisor or a lead non-commissioned officer or commissioned officer who is also on-duty.
6. In fire/life safety training, "safety" implies the absence and/or control of conditions that can cause personal injury or death or that can damage or destroy equipment or property. Within the system, safety is concerned with the elimination or control of factors affecting the safe, efficient operation of personnel, equipment, and facilities organized to attain a common goal.

   The objective of safety "training" is to insure maximum freedom from inadvertent, potentially destructive mishaps resulting from facilities, equipment, procedural, or personnel deficiencies during all phases of system operation. (70) 15-30

issues and assumptions

1. Three-shift versus four-shift impact on training time available

Most facilities operate on a three-shift basis:

Day shift:	8 a.m.	4 p.m.
Swing shift:	4 p.m.	Midnight
Midshift:	Midnight	8 a.m.

By having personnel assigned to four shifts instead of three, one group could be a training shift that would be on duty during the day shift period; thus the peak activity period would have double the personnel available if required, plus give training exercises the most opportunity to interact with actual facility functions.

The four-shift concept, however, assumes one or both of the following:

a. More people will be assigned to the site.

b. Staffing of the three operating shifts can be reduced.

activities

Personnel support

1. Relaxing.
2. Reading.
3. Eating.
4. Storing food.
5. Preparing food.
6. Storing personal items, i.e., coats, books.

personnel

1. Two to eight at once.

equipment *

1. Refrigerator.
2. Range with hood.
3. Sink (20 by 30 inches) in countertop, with cabinets above.
4. Coffee machine.
5. Table with five chairs.
6. Bulletin boards.
7. Trash receptacles.
8. Coat rack.
9. Microwave oven (if communication equipment is not affected).

* see "guidance" box for example layout of all equipment listed.

activities

1. Evaluating personnel records and conducting personnel interviews to determine training requirements.
2. Developing overall master training and presenting special MOS training module program for a specific focus.
3. Reading/studying manuals and publications.
4. Watching video cassettes, 16-millimeter movies, and slides.
5. Providing fire/life/mission safety instruction.

personnel

Instructors

1. Commander.
2. Noncommissioned officer in charge.
3. Civilian technicians (not an office area for personnel).

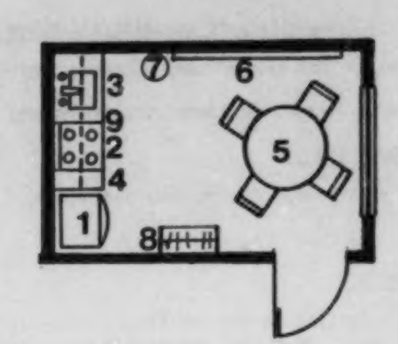
equipment

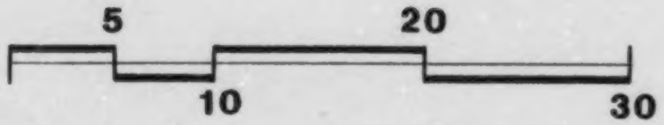
Classroom/conference

1. Table and seating for four to eight.
2. Viewgraph projector.
3. Charts and display panels.
4. Audiovisual projector and screens.
5. TEC library monitors.
6. Chalkboard.
7. Tackboard for training and information bulletins.
8. Intercom speaker.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the personnel support/break area.	**1.** Provide approximately 150 to 200 square feet of space for equipment and furniture to accommodate up to six personnel.	
2. Visual separation from the communications equipment.	**2.** Provide visual separation that also allows viewing of the operations area when desired. Supply comfortable furniture and carpeting (earth tones are recommended).	
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Vinyl asbestos tile and area carpeting. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation for a nondisruptive environment.	**4.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**4.** See reference 201, page 3-4, Table 3-2.
5. Lighting suitable for reading (task and ambient).	**5.** Use 20 to 30 footcandles for ambient lighting and 100 footcandles for task lighting.	
6. Thermal comfort.	**6.** Control temperature for 68°F (heating) and 78°F (cooling) with a 5-cubic feet per minute per person outside air ventilation rate.	**6.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Provide 120/208 electrical service. 120-volt outlets should be installed for every 10 linear feet of wall. Counter height outlets are required for a coffee maker, mixer, microwave oven (when permitted), and other appliances.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**8.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety for more information.

guidance





guidance

1. Location

The personnel space should be directly adjacent to the operations room, but isolated acoustically (absorptive walls) and visually (a curtain hung at the window).

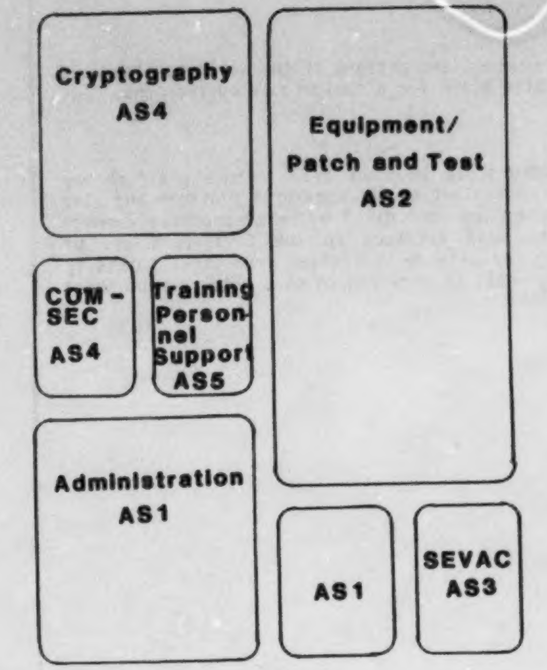
3. Visual comfort

The color contrast, textures, and designs of the wall, ceiling, and floor surfaces should minimize glare for a comfortable environment.

5. Lighting design

Classroom lighting immediately in front of a lecture platform may be controlled from a point convenient to the speaker's platform and also at the entrance. Lighting may be controlled by motor-operated dimmers from the platform and the main entrance to the facility's use of audiovisual aids. Lighting may also be controlled from those points by switches. Minimum lighting shall be provided so that notes may be taken during the use of visual aids.

STANDARDIZED MODULES AS6



building design principles

1. Efficiency of operational functions

a. Communication equipment aligned for surveillance and access.
b. On-the-job training with operating equipment.
c. Interaction of operational support activities.

2. Efficiency and accessibility of administration spaces

a. Administration transition space between public areas and secure spaces.
b. Efficiency of integrated administrative spaces.

3. Personnel support spaces

a. Change of environment for on-duty personnel.

4. Facility expansion

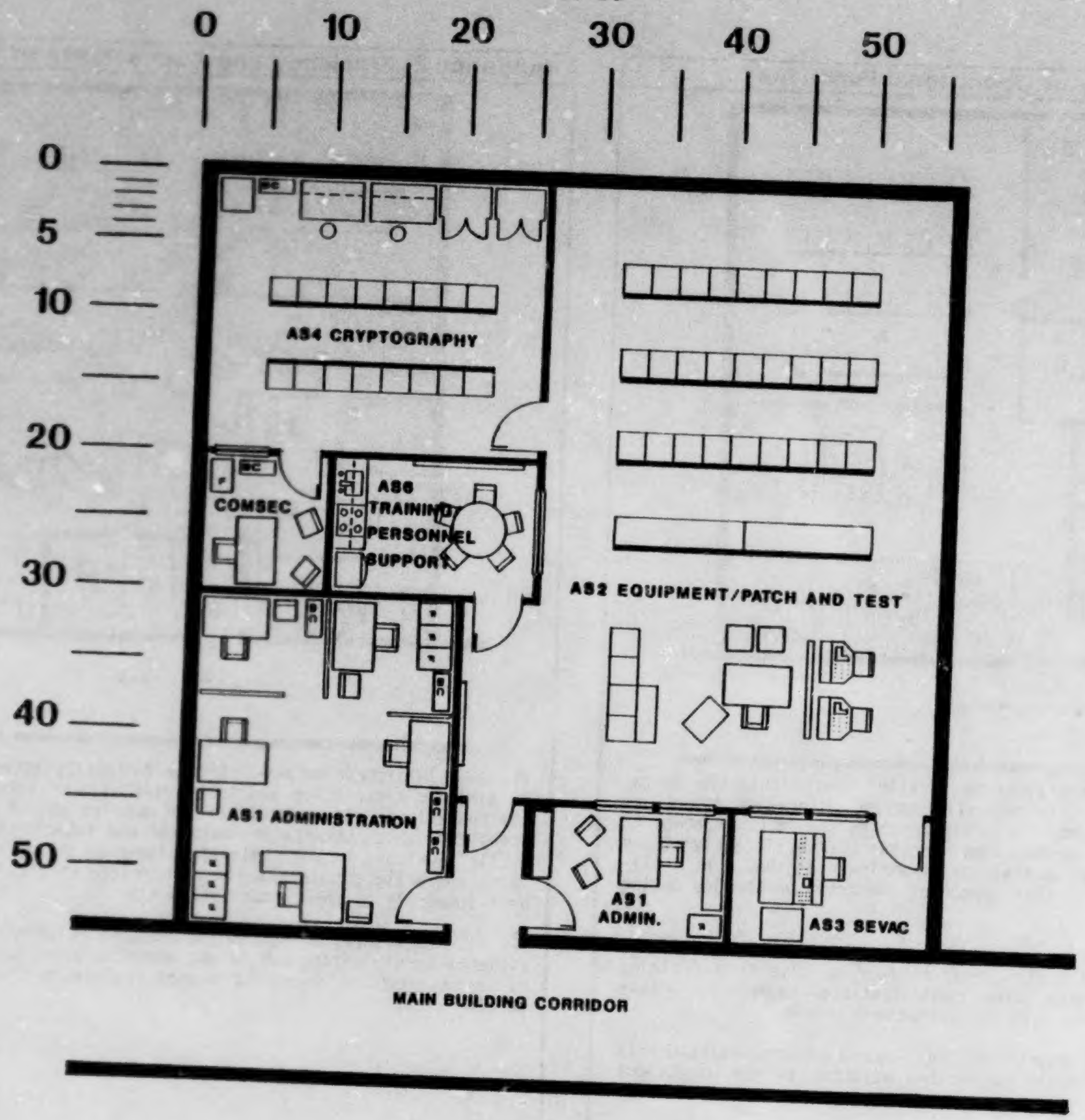
a. Expansion potential in new construction operations space.
b. Minimized impact of future operations space expansion.

5. Fire protection

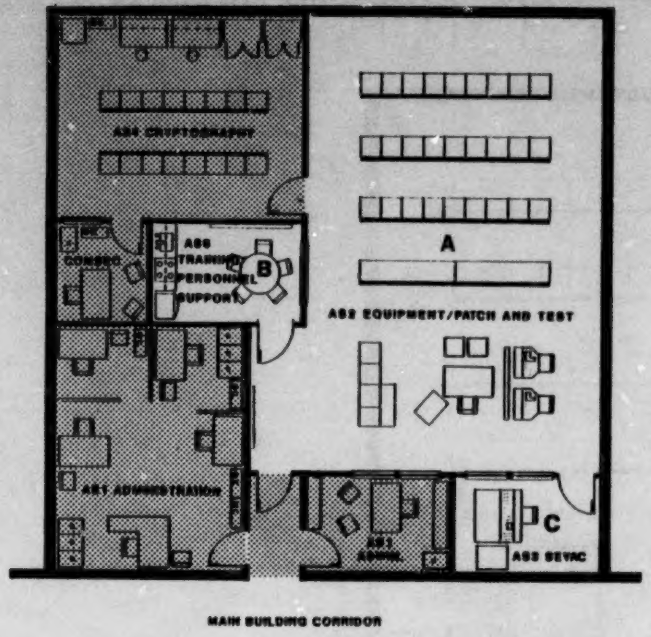
a. Fire protection classifications: occupancy, hazard of contents, sprinkler protection, and construction/materials.
b. Building separation distances.
c. Fire protection systems: automatic fire suppression, automatic notification/alarm, and automatic fire detection.

6. Life safety

a. Occupant load determination.
b. Protected exit conditions: exit capacities, number of exits, exit travel distances, and means of exit arrangement.
c. Allowable interior finishes.
d. Egress path identification: illumination of means of egress, emergency lighting, and means of egress marking.


AS4 CRYPTOGRAPHY
COMSEC
AS6 TRAINING PERSONNEL SUPPORT
AS2 EQUIPMENT/PATCH AND TEST
AS1 ADMINISTRATION
AS1 ADMIN.
AS3 SEVAC
MAIN BUILDING CORRIDOR

guidance 1. Efficiency of Operational Functions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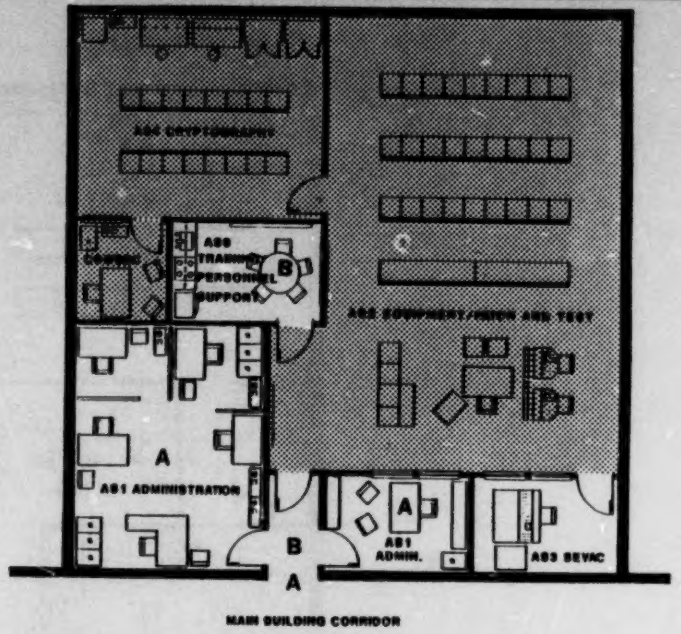
AS3 SEVAC
MAIN BUILDING CORRIDOR

A. Equipment should be aligned in parallel rows within the operations modules for ease in visual surveillance and to provide direct access to all critical equipment. Multiple consoles should be adjacent to each other so that limited personnel can monitor them efficiently at one central location. Tables for audiovisual training aids should be available in operations modules so that personnel can train on-the-job during regular watch periods.

B. To further enhance the effectiveness of on-the-job training, instruction can be done in small groups of four or five in a training room for hands-on experience with communications equipment. This requires a close relationship with the operations module.

C. Additional building modules with a close functional relationship to operations activities should be located adjacent to the operations module.

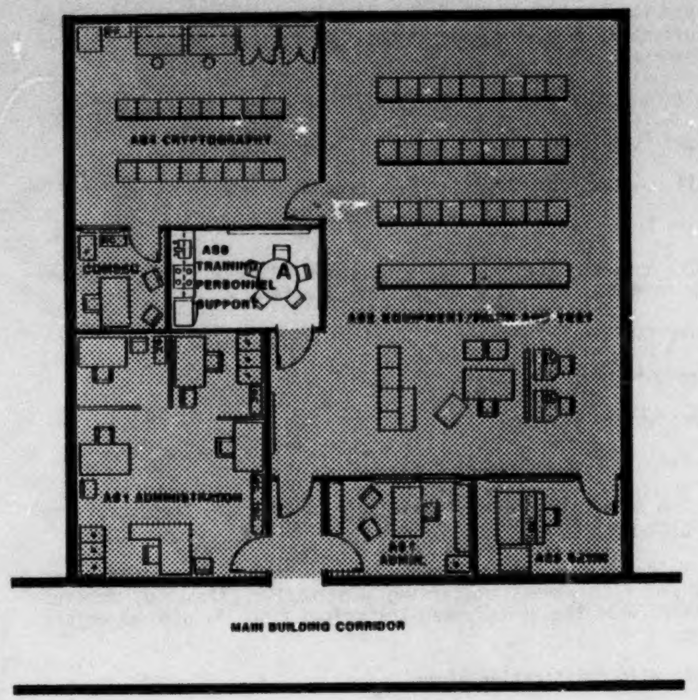
guidance 2. Efficiency and Accessibility of Admin. Spaces


AS4 CRYPTOGRAPHY
COMSEC
AS6 TRAINING PERSONNEL SUPPORT
B
AS2 EQUIPMENT/PATCH AND TEST
A
AS1 ADMINISTRATION
A
AS1 ADMIN.
AS3 SEVAC
B
A
MAIN BUILDING CORRIDOR

A. Administration modules must be easily accessible to the public to minimize circulation and to prevent visitor interference with facility operations. The administration modules should provide a buffer and transition space between the exterior and interior secure spaces. Also, public corridors in the administration area should contain military unit logos and other display panels that relate to the "esprit de corps" and unit integrity of the communication station.

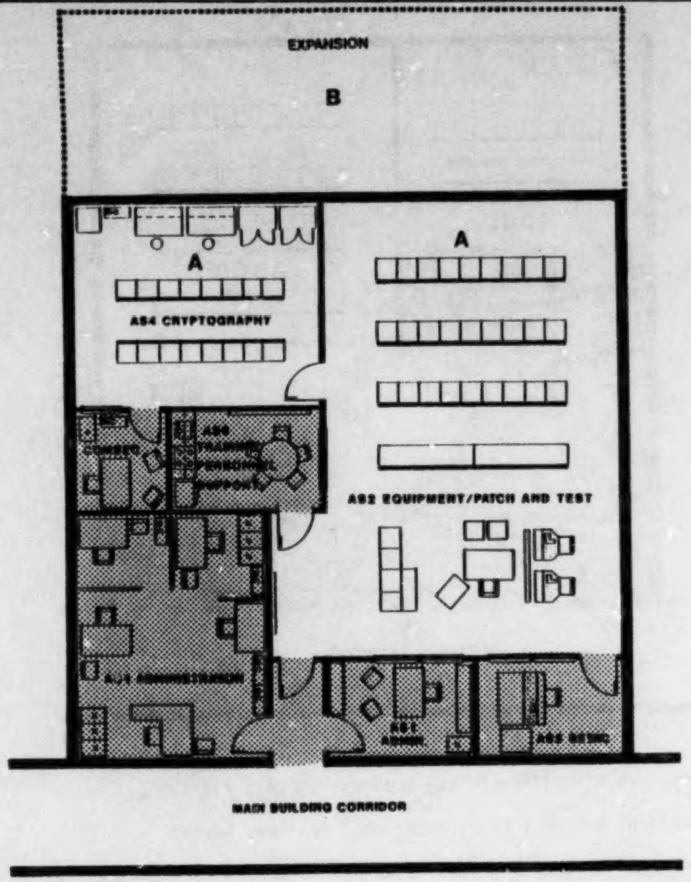
B. Administration spaces' integrated relationship will improve efficiency by minimizing public and administrative circulation and by producing a group adjacency to shared conference areas, secretaries, and waiting areas.

guidance 3. Personnel Support Spaces


AS4 CRYPTOGRAPHY
CONTROL
AS6
TRAINING
PERSONNEL
SUPPORT
A
AS2 EQUIPMENT/PATCH AND TEST
AS1 ADMINISTRATION
AS1
ADMIN.
MAIN BUILDING CORRIDOR

A. The intense activities inside the DCS facility tend to generate mental fatigue among personnel. It is therefore necessary to create a change of environment for on-duty personnel to provide a break from the "hard surface" equipment room and work areas. The personnel support module should be directly adjacent to the operations room, but isolated acoustically and visually.

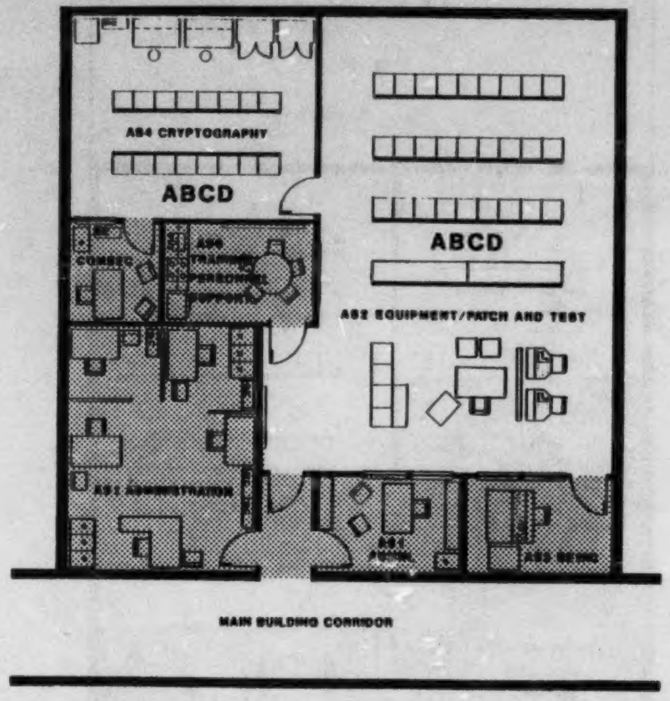
guidance 4. Facility Expansion


EXPANSION
B
A
A
AS4 CRYPTOGRAPHY
AS6
TRAINING
PERSONNEL
SUPPORT
AS2 EQUIPMENT/PATCH AND TEST
AS1 ADMINISTRATION
AS1
ADMIN.
MAIN BUILDING CORRIDOR

A The equipment layout should be planned in a way that affords enough space for the installation of equipment capable of handling the maximum projected traffic load. The initial equipment layout should be such that the station facility's ultimate expansion can be done without extensive rearrangement of existing equipment.

B. Operations modules should be functionally isolated from support and power modules. Because of the increasingly rapid changes in communications technology, new demands on the spatial layout of operations modules can be expected in the future. Such spaces must be able to expand to accommodate new equipment and new functions.

guidance 5. Fire Protection



Occupancy classifications: Business (NFPA); B-2 (UBC)

Hazard of contents classification: Ordinary hazard

Sprinkler protection classification: Ordinary hazard--group 2.

Construction classifications/materials for fire protection (See Vol 2, the first figure in SB3, Fire Protection/Life Safety)

A Type II--One-Hour (UBC) for battery, cryptography (RED/BLACK),* custodian, generator, operations,* mechanical, and transmission spaces:

All construction elements.......1-hour rated construction

Type II--N (UBC) for remainder of building spaces

All construction elements.......Noncombustible construction

Building Separation

Site-specific information is required. Comply with the second figure in Vol 2, SB3, Fire Protection/Life Safety.

Interior finishes

See Guidance/Life Safety, Vol 2.

Fire protection systems

Automatic fire suppression

A water sprinkler system shall be provided throughout the entire facility.

B A Halon 1301 or carbon dioxide system shall be provided under raised floor areas containing nonmetallic, sheathed, exposed cables when the space under the raised floor is used as an air plenum.

Automatic notification/alarm

A general alarm must be activated by the automatic sprinkler system.

C Local alarms are required to sound only in the designated spaces; they are activated by smoke detectors.

Automatic fire detection

D Smoke detectors are required to activate local alarms only in the designated spaces. In rooms containing raised floor areas, smoke detectors shall be located under the raised floor.

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*See Vol 2, SB7, Security, for vault construction requirements that may be more stringent than those imposed by fire protection requirements.

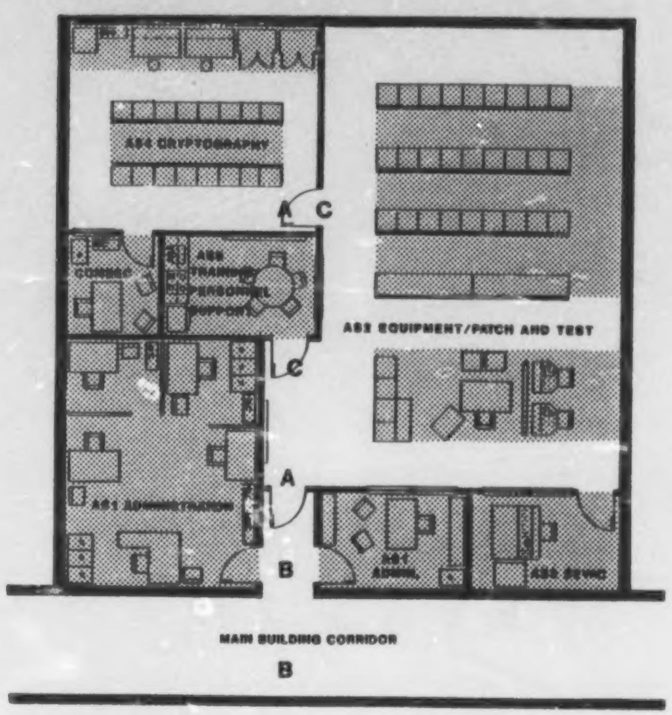


TABLE AS-1. OCCUPANT LOAD FOR DETERMINING EXIT REQUIREMENTS.

Occupant Load Factor: 100 sq ft/person based on gross floor area (Business Occupancy-NFPA)

Occupant Load= (total facility) $\frac{3025 \text{ sq ft}}{100}$ = 30 persons

Occupant Load= (vaulted area) $\frac{2100 \text{ sq ft}}{100}$ = 21 persons

Occupant Load= (admin/support) $\frac{925 \text{ sq ft}}{100}$ = 9 persons

Exit capacities

Corridors--100 persons per unit of exit width for travel in either direction. The minimum width of any exit access corridor or passageway shall be 44 inches in the clear.

Doors--100 persons per unit of exit width (a 3-foot door provides 1.5 units of exit width, providing an exit capacity for 150 persons).

Number of exits

No less than two exits shall be accessible from every part of every floor. One exit is permitted when the room or area has: (1) a total occupant load of less than 100 persons, (2) direct exit to an open area outside the building at the ground level, and (3) a total travel distance on the same level of not over 100 feet. (If stairs are involved, they shall be no more than 15 feet in height and shall be provided with complete enclosures to separate the stairs from any other part of the building.)

Exit travel distances

Required exits shall be located to allow access without passage through areas that may be locked. No dead end corridor shall exceed 50 feet. Travel distance to exits shall be no more than 300 feet when the building is protected throughout by an approved automatic sprinkler system.

Arrangement of means of egress

Exit access and travel routes to exits are shown in the plan.

A Exit doors in vaulted areas that contain communications equipment are secured and permit egress out only. Exit access routes through vaulted areas from spaces outside the vaulted area are not permitted for security reasons.

B Interior finish in exit access corridors shall be Class A only. Interior finish in the rest of the facility shall be Class A or B only.

guidance

Means of egress lighting

Exits and exit access, including stairs, aisles, corridors, and passageways leading to an exit, shall be lighted continuously during times when the conditions of occupancy require means of egress to be available. Lighting should be no less than 1 footcandle measured at the floor.

Emergency lighting

Emergency lighting shall be provided in windowless buildings for designated aisles, corridors, and passageways leading to an exit. Emergency lighting shall stay at least 1 footcandle throughout the means of egress for 1.5 hours in the event of normal lighting failure.

Marking the means of egress

Exits shall be marked by an approved sign readily visible from any direction of exit access. Signs shall be placed such that no point in the exit access is more than 100 feet from the nearest visible sign.

C Doors located or arranged so that they are likely to be mistaken for exits shall be identified by a sign reading "NOT AN EXIT."

European Telephone System (ET)

	European Telephone System (ETS)	ET-1
ET1	ETS Equipment	ET-2
ET2	Parts/Maintenance	ET-10

ETS EQUIPMENT ET1

ET1
ETS Equipment

ET2
ETS Parts/Maintenance

function

To provide space for upgrading a general purpose, integrated telephone system to support the command and control, logistical and administrative voice communications requirements for DOD components in Europe.

policy/sop

1. The initial implementation of the European Telephone System program, as directed in the Joint Chiefs of Staff-approved DCS European Telephone System Plan, will consolidate three separate voice networks; the U.S. Army Europe (USAREUR) Direct Distance Dial Network, the USAREUR Dial Service Assistance Network, and the U.S. Air Force Europe (USAFE) VF Dial Network in the Federal Republic of Germany (FRG). The approved ETS includes those switch replacement projects in the FRG, Benelux, and Italy; it is also to include future approved and funded telephone switch replacement programs in Europe. The program provides for the replacement of service operated and maintained switches with state-of-the-art equipment. This switch replacement program will reduce operation and maintenance requirements, improve service by fulfilling U.S. Commander in Chief, Europe USCICNEUR general purpose telephone requirements, and support command and control needs. (34) 1-1

2. The original ETS program was initiated to replace the antiquated analog voice switch systems in the FRG; the primary objective was to upgrade the administrative voice communications capability among bases, posts, camps, and stations in the FRG. Modern digital switching equipment provides a capability for much more than just administrative voice communications. The Digital European Backbone (DEB) transmission system also is being installed in Europe, which improves the capability to provide a digital communications network that can provide combat essential communication for U.S. forces in Europe. The opportunity now exists to upgrade voice communications for U.S. forces in Europe using modern digital technology.

   a. Existing switches will be replaced by a single family of current commercial design switches to reduce life cycle support costs through standardization.

   b. As a minimum, the ETS will be able to interface both the European AUTOVON and the host nation's telephone system.

   c. DCA will exercise operational direction and management control of the ETS' DCS portion for maximum responsiveness, effectiveness, and compatibility.

   d. Additionally, to take advantage of the ETS digital voice switches' inherent capabilities, the Joint Chiefs of Staff have directed the:

(1) Development of a system architecture for the ETS that will provide the command and control voice communications for U.S. forces in the European theater by the most cost effective methods and include appropriate consideration of network features that will improve survivability.

(2) Incorporation of current and future nontactical voice switch requirements in the European theater into the overall ETS architecture.

(3) Development of engineering specifications and interface standards and criteria for all nontactical voice switches interconnecting the ETS.

(4) Exploration of options/methods to integrate ETS into the AUTOVON/Defense Switched Network (DSN). (34) 1-2

3. The ETS switching facilities will be upgraded and replaced in such a way that the system will continue to provide continuous, uninterrupted telephone service to all users, to the maximum extent possible, during implementation. Cutover of the individual implementation phases will be identified in the IIP and coordinated by the LMD with DCS, MILDEPs, DCA-Europe, and other agencies as appropriate. (34) 4-1

4. The Director, DCA, will exercise overall operational direction of the ETS in accordance with DOD Directive 5105.19, which defines operational direction as the:

> Authoritative direction necessary to insure effective operation of the DCS. It includes authority to: direct the operating elements of the DCS, assign tasks to these elements, and supervise the execution of those tasks; allocate and reallocate DCS Facilities to accomplish the DCA mission; develop technical standards, practices, methods, and procedures for the performance and operation of the DCS; and analyze the system performance and operation of the DCS.

5. DCA will delegate the day-to-day responsibility for ETS system control to DCA-EUR. DCA will establish a Network Control Facility (WWOLS/NCF) at the DCA-Europe Area Communications Operation Center (ACOC). Similar facilities, called Service Control Facilities (SCFs), will be installed at selected U.S. Army and U.S. Air Force locations in the European theater. Either of these facilities could assume system control functions in the event of a catastrophic failure of the DCA-EUR WWOLS/NCF, enabling the U.S. Army and U.S. Air Force to manage the ETS day to day. With these facilities, DCA and the MILDEPS would be able to remotely monitor the status of the network on a real-time basis and to take actions necessary to control and regulate traffic flow. (34) 4-4

6. The ETS structure consists of interconnecting transmission, switching, maintenance, service control, and network control facilities. All required information will be derived from the switches and interconnecting transmission resources and routed upward to support maintenance, administration, and network/management control functions. Status, diagnostics, traffic accounting, and configuration data are streamlined to provide the level of detail needed to support a particular function. Maintenance facilities will receive alarms and detailed diagnostic reports, process the reports, and route summary reports to the SCF for further analysis and displays. Concurrently, summary status reports will be generated at SCF and routed to the WWOLS/NCF at the ACOC. These reports will be generated at the switch automatically in a message format, on an exception or periodic basis, depending on diagnostic indications and variable thresholds that can be controlled remotely from SCF. Capability will be provided to query event files and retrieve automatically the more detailed data collected and stored at lower levels in the switching hierarchy. Directive messages will disseminate controls, reconfigurations, instructions for program changes, and data base updates. As required, coordination messages will be routed upward to acquire concurrence or lack of concurrence on directives. (34) 4.4

7. The ETS shall be composed of three levels of electronic automatic digital dial exchanges: End Offices (EOs), Intermediate Switching Centers (ISCs), and Tandem Switching Centers (TSCs). The ISCs will generally combine both ISC and EO functions, whereas the TSC will generally combine TSC, ISC, and EOs within a single switch. All new switches (TSC, ISC, and EO) shall be based on pulse code modulation (PCM) digital technology using a single family of equipment within an area which shall be electrically and mechanically interchangeable so as to provide standardization and reduce life cycle support cost. The switches shall interface with the U.S. analog and digital backbone transmission systems and with host nation transmission carrier systems.

a. All EOs shall be controlled by electronic processors of current commercial design, and shall be representative of a single family of switches to the maximum extent possible. Switching functions shall be based on a common technical concept, with emphasis on common architecture, hardware features and maintenance techniques. EOs shall have modular expansion capability and shall process dialed digits and special service numbers, provide primary and alternative route translation, and provide for four levels of AUTOVON Precedence with Preemption. Remote Switching Units (RSUs) can be added later to provide the capability to remote large numbers of user lines under control of the EO central processor.

policy/sop

b. All ISCs and TSCs shall be able to perform the same functions as an EO plus the following:

  1. Route nonlocal and tandem calls.

  2. Perform routing and alternate routing, depending on availability of connecting trunks, call precedence, and type of call.

  3. Provide routing translation to EOs sharing access codes.

  4. On calls to certain locations, delete and/or add digits and outpulse required digits or send no digits (seize and ring) after translation. (34) 5-7

8. The ETS switches shall be equipped at selected locations with Dial Service Assistance (DSA) consoles. DSA consoles shall have the following features.

  a. Visual display of incoming calls, i.e., type of call, station, ETS, public network with class of service, and AUTOVON with four levels of precedence.

  b. Provision of DTMF (16-button pad) to provide address signaling and to signal one of four levels of precedence to the switch processor.

  c. Verification of busy.

  d. Visual display of incoming Redline manual trunk or AUTOVON calls in queue.

  e. Ability to use preemption on every station or trunk.

issues and assumptions

1. DCS portion of the ETS versus non-DCS portion; The boundary between the DCS and the non-DCS part of the ETS is defined on a functional basis. Therefore, for management and control, the ETS is divided into two functional subsystems, the first being subscriber functions and the second being network functions. Functions that deal exclusively with base/post/camp/station operation and management will remain the responsibility of the O&M commands. The DCS portion of the ETS consists of the following elements:

  a. TSC to TSC interswitch trunking and trunk switching functions.

  b. TSC to ISC interswitch trunk switching functions.

  c. ISC to ISC interswitch trunking and trunk switching functions.

  d. Access lines from ISC inward to the end offices.

The management control and operational direction of the ETS dual function switches, that is, those switches performing both DCS and MILDEP functions, will be divided between DCA and the MILDEPs.

The non-DCS portion of the ETS shall consist of:

  a. Subscriber facilities
  b. O&M command functions.

    1. Approval for local service and local special service features.

    2. Class of service (class marking).

    3. Class of service ratios (within MOP 151 constraints).

    4. Percentage of fill.

    5. Control and monitoring of precedence and maximum call area.

  c. Local subscribers switching hardware/software.

Some functions performed in the non-DCS portion of the ETS naturally will affect the network as a whole. Detailed management procedures will be formulated to prevent actions initiated within an EO from having deleterious effects on the entire system. (34) 1-4

issues and assumptions

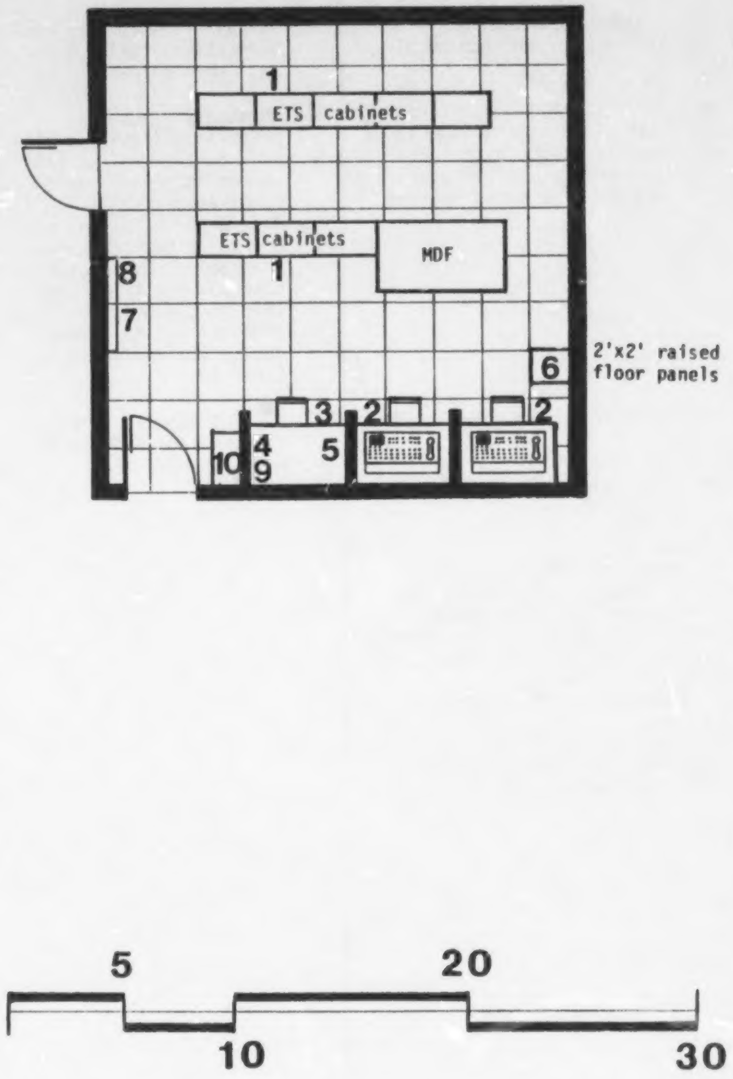
2. Determining the correct shielding procedure: A comprehensive approach to shielding equipment from radiofrequency interference (RFI) or TEMPEST involves (a) a building layout to optimize inherent facility shielding conditions, (b) appropriate location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components. See Vol 2, SB4, for additional guidance.

activities	personnel	equipment*
1. Monitoring communication equipment (patch and test). 2. Isolating faults. 3. Performing quality control maintenance tests. 4. Troubleshooting and patching to good equipment. 5. Identifying bad connections. 6. Writing/typing reports. 7. Conducting training sessions.	1. One or two personnel per shift, plus shift supervisor.	1. Electronic FTS communication equipment. 2. Control console(s). 3. Desk with chair. 4. Telephones. 5. Typewriter(s)/word processor(s). 6. Filesafe. 7. Electrical shock first-aid kit. 8. Alarm panel. 9. Operational voice intercom control. 10. Record file (10 drawers). * see "guidance" box for example layout of all equipment listed.
Dial assistance area 1. Assisting dial users (where required).	1. Varies; two to six, depending on subscriber requirements.	1. Dial assistance console.

requirements	criteria	commentary
1. Enough space for a layout to accommodate the inspection and testing of communication equipment.	**1.** Approximately 400 square feet; however, specific sites vary due to the extent of communication equipment designed. A 36-inch workspace behind all equipment for inspection, testing, and repairs is required.	**1.** For retrofit or upgrading projects, the existing electromechanical switching equipment may require relocation to permit the installation of TSCs and ISCs with associated power equipment. Arrangements may need to be made for a transportable switch during the time required to dismantle existing equipment, prepare the site, and install and cutover the new switch.
2. ETS survivability/security.	**2.** ETS will be provided with increased survivability through ETS diverse connectivity; however, additional consideration should be given to the physical security of the ETS switches within present funds constraints. All TSCs, ISCs, and critical EOs, should, as much as possible, be located to provide maximum available protection in a conventional war environment, i.e., basement locations instead of top floors. (34) 8-1	**2.** See Vol 2, SB7, Security, and SB8, Survivability.
3. RFI shielding.	**3.** Shielding of electrical and electronic equipment is required to prevent it from propagating interference and to protect the equipment from the effects of interference propagated by other electronic devices. (15a)7	**3.** See Vol 2, SB4, Grounding, Bonding and Shielding, along with SB5, EMP/HEMP Protection.
4. Raised floor system.	**4.** Raised or false floors are necessary for proper cooling of the equipment.	**4.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
5. Interior finishes suitable for durability, maintenance, and room function.	**5.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor witha dusted-on finish that contains a hardener. See Vol 2, SB2, Interior Construction. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	**5.** See also Vol 2, Site and Building Information, SB2, Interior Construction and Finishes.
6. Acoustical isolation/attenuation of variable noise levels produced by electrical equipment.	**6.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile is also required to within 4 feet of the floor.	

requirements	criteria	commentary
7. Adequate lighting.	**7.** 20 footcandles ambient. 80 to 100 footcandles task for testing and inspecting.	
8. Environmental control for proper operation of electronic equipment.	**8.** 73°F (±2°). 50 percent relative humidity (± 5 percent). Filtered air is required in the equipment area. (See MIL-HDBK-411A).	**8.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
9. Electrical power.	**9.** 48 V-C for ETS equipment. 120/208 electrical service. Electric power may fall within the 10,000 to 50,000 range. Voltages are required at 50 to 60 hertz + 5-percent. Install 120-volt outlets, one for every 10 linear feet of wall and as required for coordination with equipment.	**9.** Necessary electrical power installation design and upgrade will be engineered and installed in compliance with MIL HDBK 411, NFPA 70-78, and host country electrical power standards. Commercial or base power will be used when cost-effective. See also Vol 2, SB2, Communication Station Buildings--Electrical.
10. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that would create a severe strategic fire loss potential.	**10.** Vaulted enclosure walls: 2--hour (minimum) fire-rated construction; shielded. Interior doors in vaulted walls: 1-1/2 hour fire-rated doors; shielded doors and frames. Interior finish: Class A or B only. Automatic fire detection: Local alarm. Automatic fire suppression: Water sprinklers. Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area: automatic fire detection--local alarm. Automatic Halon 1301 suppression system if cross-zoned or matrix detection is required. Sprinkler and Halon systems are not normally installed in the same areas.	**10.** See Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

4 Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on a raised floor for maximum use of cooled air directly through the cabinets. Cooling air at 60°F supplied directly into the base of the transmitters will leave at the top at approximately 72°F. Air exiting the equipment is at a more comfortable temperature for personnel working in the space.

7 Equipment area

Fixtures should be arranged above the operating aisles and running parallel to the equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so they are not obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23) 12 Portable task lighting should also be supplied for the equipment area at 70 to 100 footcandles.

8 Protection from moisture migration

Operating spaces containing electronic equipment usually require close temperature and humidity control. Vapor barriers under floor slabs and incorporated into roofing usually can prevent moisture migration into and out of the interior electronic equipment spaces. Additional protection must be provided if exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

Air-conditioning

Continuous, reliable operation of computers depends on an efficient, well designed, properly controlled air-conditioning system. Inadequate cooling contributes as much to failure as does inadequately regulated power. (74) 4-17

Even through certain individual units may be operated outside the limits of the overall specifications, the system's environmental requirements are dictated by its most restrictive unit. The computer system requirements are the major considerations in designing the air-conditioning system. However, good design also will consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning as follows: (74) 4-17

a. Heat dissipation by the computers is relatively constant; therefore, cooling is required year-round.

guidance

b. The computer room sensible heat ratio is near unity because heat dissipated by the computer system is all sensible.

c. Better-than-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.

d. Air changes per hour number between 30 and 60 because of the computer equipment's high heat dissipation.

e. Humidity control is required year-round to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas, because the vapor can damage electronic equipment. (40) 7-3

Temperature and humidity instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Also, if air-conditioning requirements are not met, a record is available to indicate the extent and duration of the undesirable condition and indicate whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used: (74) 4-25

a. To insure that the air-conditioning installation continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some part of the air-conditioning system can be detected quickly.

b. To determine if a mandatory drying-out period is necessary when humidity limitations have been exceeded. Drying-out may be necessary if the excess humidity occurs either during actual operation or when the machine is shut down and unattended. The extent and duration of the excess humidity will determine the duration of the drying-out period.

c. To determine if the environment in the area meets the requirements for the machine.

It is desirable that the instrument have a visual or audible signal device to indicate when the temperature or humidity in the computer area is nearing the maximum limitations. Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor the ambient room conditions. The recorder usually is located at a spot representative of conditions in the room and adjacent to the control devices.

For monitoring underfloor air conditions, a remote indicating instrument is recommended. This is usually a 7-day electric drive chart and can be the wet and dry bulb or electronic type if direct reading is not available. The recording instrument can be located on the wall in the same room, in the mechanical equipment room, or at any other location convenient to the building engineer.

guidance

An air-conditioning system for a computer and switch installation sometimes requires supplies dedicated to each unit. Input is from below as shown in the figure. An alternative source of air also should be available.

9 Electrical power

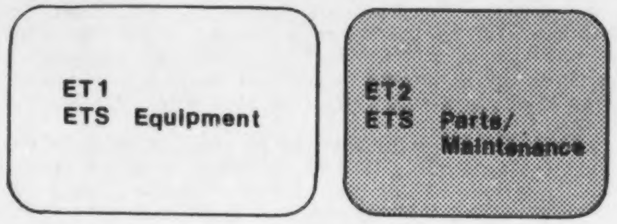
The power distribution and switching system will be designed to permit simple, rapid switching of the station load between primary and secondary power sources. Standard DOD Mobile Electric Power (MEP) Generating Equipment will be used when practical. The DOD program manager for Mobile Electric Power Generating Equipment will be consulted for the selection of standard power sources to prevent procurement of nonstandard items to meet the requirement for this MEP. (34) 8-2

Lead calcium storage batteries shall be provided to maintain a busy hour reserve of 8 hours for TSC, ISC, EO, or combined switch operation as applicable. Capacity shall be such that full system operation on battery (loss of primary rectifier system) can be maintained for 8 hours and batteries can be fully recharged within 24 hours. Storage batteries shall be the closed cell type. Cells shall be explosion-proof construction and equipped with explosion-resistant vent plugs. Battery racks shall be a double-tier, two-step, seismic-resistant configuration. See Battery Room, V09, of the AUTOVON/DSN facility modules. (34) 8-2

Specifically refer to the "Electrical" portion of "Issues and Assumptions" portion of SB2, Vol. 2, for information relative to host nation power requirements. Additional information may be found in "guidance" of SB2 with respect to the standard frequencies and voltage levels used by various nations.

Provide host nation standard outlets of applicable.

ETS PARTS/MAINTENANCE ET2



function

To provide space required for managing all parts supply operations--ordering, receiving, storage, inventory, and security--and for the assigned personnel and shift supervisor who repair, clean, and test communication equipment.

policy/sop

1. During preventive maintenance inspections, it will be noted from time to time that some component's performance has deteriorated. Rather than wait for the component to become weaker or to fail completely and interrupt the system, it is considered good maintenance practice to replace weak components during the inspection. Thus, although components are replaced before their full service life has been realized, service interruptions can be avoided. This practice will, in turn, increase the expected replacement parts costs for an operating system; however, the increase is justified on the basis of increased system reliability and the savings of additional manpower costs that would be incurred requiring special rush trips to restore station operation. (70) 7-49

2. It is desirable to provide a separate parts/maintenance room to allow space for repair activities and the associated test equipment and tools. The space required will, of course, depend on the amount of electronic communication equipment installed, the number of maintenance personnel involved, and the spare parts stocking requirements.

3. To test and service a DCS communication system properly, maintenance personnel should have a thorough understanding of the equipment's physical makeup, operational characteristics, capabilities, and limitations, and should be familiar with the circuit theory of operation. It is equally important that the proper test equipment be available to these personnel. As the area of maintenance progresses from onsite field maintenance to depot maintenance, the amount and requirements of the test equipment needed will increase, necessitating improved facility responsiveness. (70) 7-51

issues and assumptions

1. Contract technicians versus military personnel. Civilian technicians under contract have replaced military personnel in many cases, due to the increased use of leased equipment. Contract personnel require a desk, workbench, and lockable storage cabinet in the maintenance space.

activities

1. Developing parts order lists, working with station central supply office.
2. Receiving, unpacking, shelving prescribed load list and facility supply parts.
3. Packing and shipping repairable items.
4. Performing complete preventive and unscheduled maintenance.
5. Testing electronics.
6. Providing secure storage of parts and equipment.
7. Maintaining records on parts and equipment.
8. Writing/typing reports: PMI 349s, equipment historical records.

personnel

1. Shift supervisor.
2. One or two specialists.

equipment *

1 Electronic work bench w/stool with shelving over workbench for publications/manuals.

2 Desk with chair for parts ordering, microfiche unit.

3 Bookcase for supply manuals - 3 to 4 in. ft.

4 File cabinet.

5 30" x 60" table w/chair.

6 Shelving for equipment and parts 30 in. ft. of floor-to-ceiling shelving.

7 3 locked cabinets (24" x 36").

8 Intercom speaker.

9 Wall mounted test equipment over workbench.

10 Portable power supply test set.

11 2 scope carts.

12 Multiboard (24"x48")

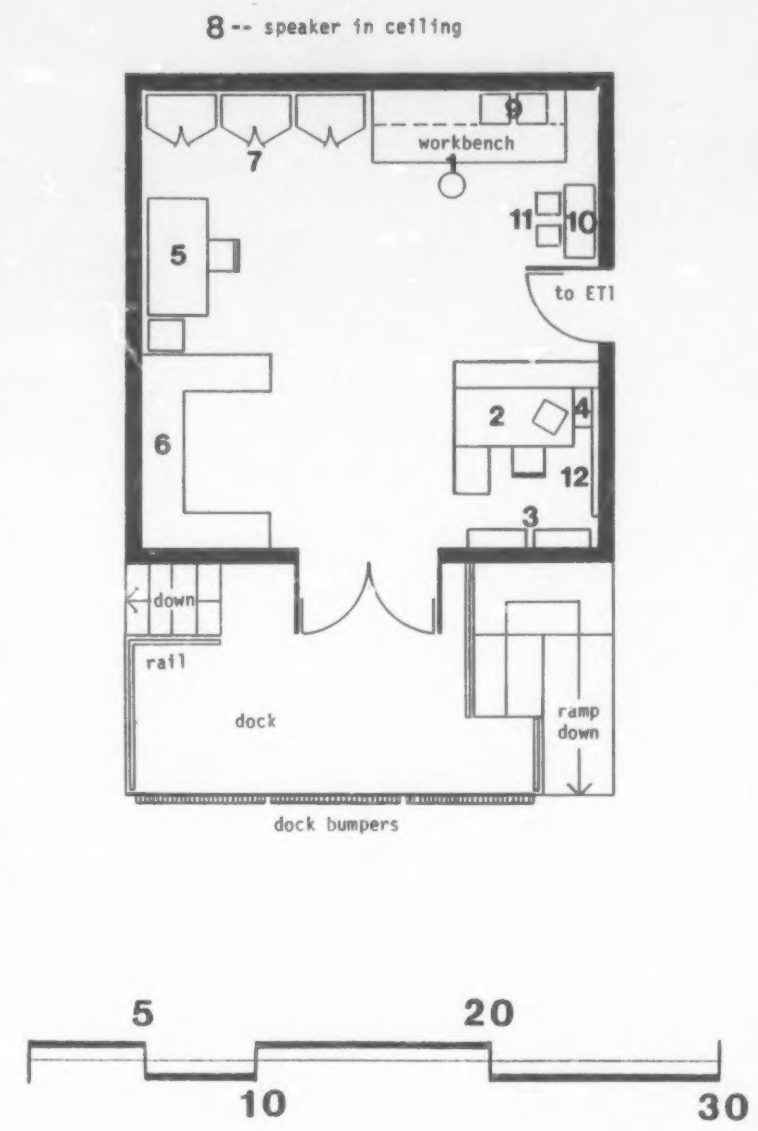
13 Telephone.

14 Portable vacuum cleaning system to clean equipment parts. If compressed air blower unit is used instead, use 30 psi. max. to prevent damage to parts. (Use with a dust collector.)

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for the inspection, disassembly, and assembly of sensitive electronic equipment. Space also must accommodate the administrative, tool, and parts storage needs.	1. Approximately 400 square feet; see Guidance for typical layout.	
2. Security for equipment and materials.	2. Lockable when unstaffed.	2. See Vol 2, SB7, Security (Zone 3), for more information.
3. Monorail hoist.	3. Provide a 2-ton monorail hoist to facilitate transport of communication equipment.	
4. Exhaust fan to remove fumes and gases over workbench.	4. Ventilation capacity of 4 air changes per hour.	
5. Interior finishes suitable for durability, maintenance, and room function.	5. Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	5. See also Vol 2, Site and building Information, SB2, Interior Construction and Finishes.
6. Acoustical isolation/attenuation to eliminate C-E equipment noise and aid concentration when personnel work on electronic components.	6. Walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .90, floor surface at NRC .50, and divider partitions (if used) at .85	
7. Adequate lighting.	7. Provide 70 footcandles ambient, 150 footcandles task.	7. For further information on lighting design quality using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
8. Comfort: Thermal. Occupant.	8. 68°F (heating); 78°F (cooling). Outside air ventilation rate of 5 cubic feet per minute per person.	8. See also Vol 2, SB2, Communication Station Buildings--Mechanical.
9. Electrical power.	9. Install 120/208 electrical service. The 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and/or every 10 linear feet of wall. Provide four duplex receptacles at each workbench along with 220-volt receptacles where required. All equipment and workbenches must be grounded. Frequency levels should be 50 to 60 hertz ± 5 percent.	9. See also Vol 2, SB2, Communication Station Buildings--Electrical.
10. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	10. Interior finish: Class A or B only. Automatic fire suppression: water sprinklers. Automatic notification/alarm--general alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	10. See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1 Layout

Locate parts shelving between exterior receiving dock and maintenance area.

Provide an open area for unpacking equipment before it is moved into equipment rooms.

Loading dock

The loading dock should be designed for a minimum load of 250 pounds per square foot and for adequate room to maneuver equipment.

2 Door security

Mainterance/utility entrance doors not permitting ingress to equipment space should be secured with heavy cylindrical case lock and latch sets in conformance with Federal Specifications FF-H-106, and the provisions of Building Hardware Manufacturers Association Standard 601. Doors and hatches that are externally accessible and provide access to critical utilities should be secured with padlocks and hasps in conformance with Military Specifications MIL-P-43607 instead of or in addition to the cylindrical case or bored locksets specified above. (5) 3-5-9

Hardware set for secure doors should be:

- 1/8-inch thick drill-resistant hard plate on door interior.
- Secured-type hinges.
- Cypher lock with an electronic access control, electric strike, and emergency battery standby.
- Combination lock.
- Door closer (on each leaf if pair door is required).
- Wide-angle peephole.
- Foot bolt and pull chain bolt for inactive leaf of pair doors.

guidance

guidance

Message-AUTODIN (ME) ME-1
ME1 Security ME-2
ME2 Administration ME-8
ME3 Personnel Support/Break Area ME-12
ME4 Training ME-16
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ME12 UPS ME-58
ME13 Battery ME-64
ME14 Generator ME-70
ME15 Mechanical ME-76
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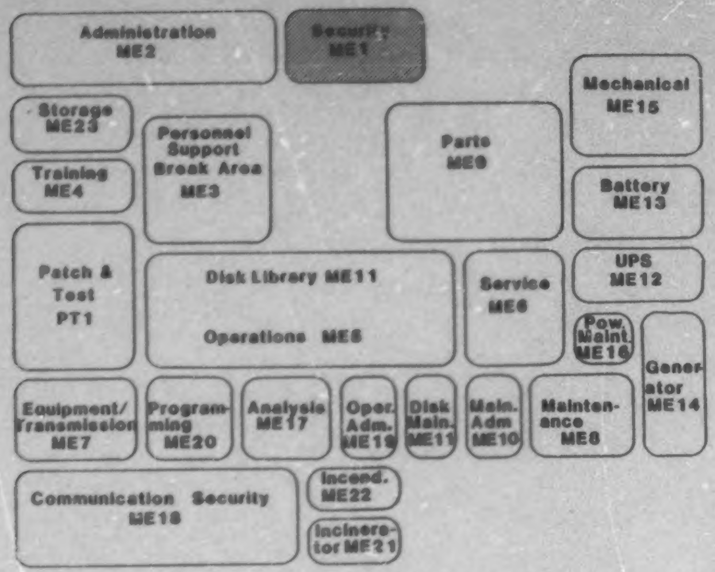
Message - AUTODIN/IAS [ME]

SECURITY ME1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Incend. ME22
Incinerator ME21

function

This component provides overview for verifying visitors before they enter the facility. The Intrusion Detection System and fire alarm equipment are monitored in this area. Also, when required, facility personnel weapons are stored and distributed here.

policy/sop

1. The building site must withstand intrusion by individuals or groups intending to compromise the security of the information transmitted and received at DCS facilities.

2. The overall approach to providing security at DCS sites consists of five elements: (1) intrusion deterrence, (2) intrusion detection, (3) alarm assessment, (4) component and physical plant hardening, and (5) security or response force personnel. Intrusion deterrence is intended to produce a psychological state of mind in a potential intruder that intrusion will result in unacceptable counteraction. Intrusion detection is intended to provide an alarm to the operating activity or security personnel that an unauthorized intrusion has occurred at a DCS site. Alarm assessment is intended to verify that an intrusion alarm was activated by a threat against the DCS site. Component hardening of the physical security system is intended to delay the damages or to limit the amount of damage that can be inflicted on a site. Security force is intended to delay, stop, or mitigate the actions of an intruder. Every DCS site security program shall be prepared to include these five elements. (9) 4.3.3.1

3. The security alarm system should also be wired into either Tech control or the operation area spaces. These spaces will be staffed 24 hours per day, and the same personnel could monitor the security system. The receiving/administrative spaces usually are staffed only 8 hours per day during the week.

4. Most OCONUS sites have local national (LN) guards that maintain security at the perimeter fence during daytime hours. At night this function reverts to site shift communication personnel. All entry alarms should be "remoted" to locations within the operations building similar to that of closed-circuit television (CCTV) monitors. This will preclude assigning critical personnel to security duties. All alarm systems should be "remotable" to the operations console.

issues and assumptions

1. Full-time lighting versus "on-demand" lighting

Continuous lighting (stationary luminaires) is the most common security lighting system. It consists of a series of fixed luminaires arranged to flood a given area continuously with overlapping light cones during the hours of darkness. Standby lighting differs from continuous lighting in that standby lighting is intended to create an impression of activity. The luminaires are not lighted continuously, but are either automatically or manually turned on at random or when suspicious activity is detected or suspected by the security force or the intrusion detection system (IDS). This technique may offer great deterrent value as well as economy in power consumption. (37) 13.1-120

2. Automatic actuation of security lighting versus manual lighting

A deterrent lighting system can be developed to turn lights on at random or, rather than randomly activating the luminaires, an IDS sensor can be used to turn on the lights when an intruder is detected. This type of active lighting system provides maximum deterrent value at a low duty cycle. (37) 13.1-124 Automatic actuation of lights for normal operations seems most advantageous; however, manual override should be provided for control.

activities

1. Viewing personnel entering the complex.
2. Monitoring IDS equipment.
3. Operating facility physical security program.
4. Distributing and storing personnel weapons.

personnel

1. One.

equipment*

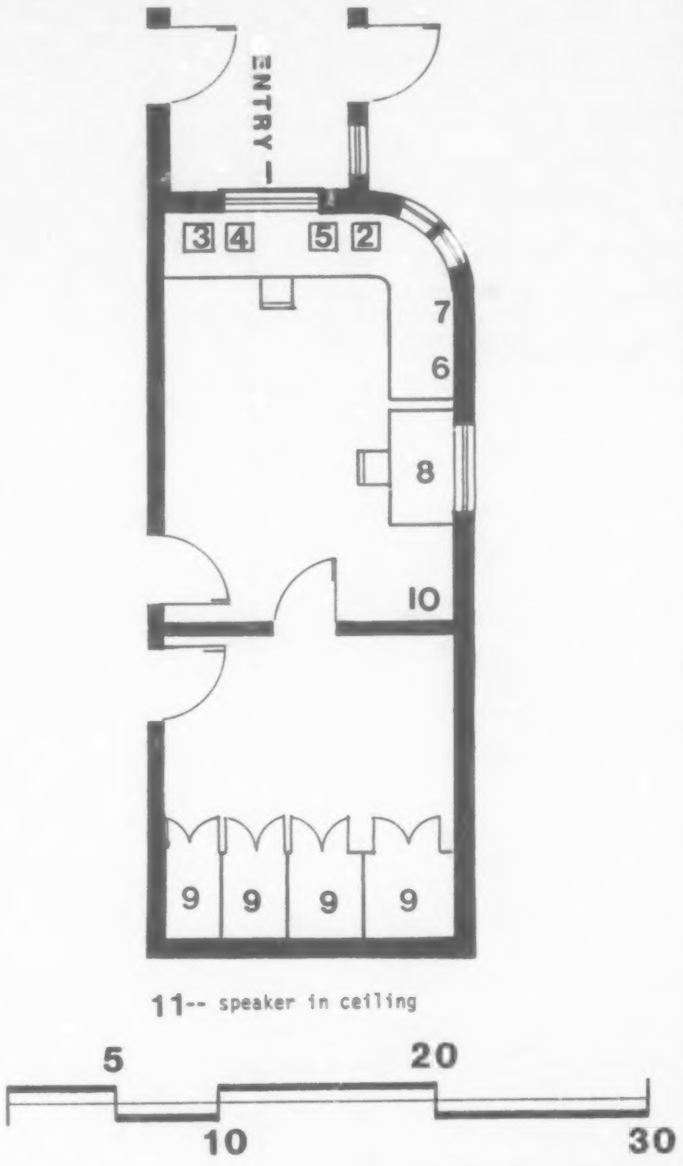
1. Pass window for identification.
2. Annunciator panel (sensor information).
3. Closed-circuit TV.
4. Gate control for perimeter security fencing.
5. Exterior lighting control.
6. Communication link to host agency.
7. Alarm for intrusion detection to host agency security office.
8. Desk (or counter unit) with chair.
9. Racks for personnel weapons. Weapon distribution is through a door with a daygate for passing through.
10. Humidifier.
11. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate IDS equipment and personnel associated with security component.	**1.** Provide space for one person who verifies and monitors the facility's security. This area varies with size of facility, but typically is 400 to 500 square feet.	
2. Visual verification of entering personnel.	**2.** Provide a pass window.	
3. Communication and electronic monitoring lines.	**3.** Coordinate IDS components into a centralized module. Provide an annunciator panel with telephone and intercom link-ups. The operation room console should have remote alarms along with a CCTV monitor.	
4. Resistance against penetration from the outside and for the armory.	**4.** Windows should be glazed and hardened to prevent penetration (bullet-proof glass). Windows also should be designed for full visibility over approaches to the point of entry.	**4.** See Vol 2, SB7, Security (Zone 3), for more information.
5. Interior finishes suitable for durability, maintenance, and room function.	**5.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**5.** See also Vol 2, SB2, Interior Construction and Finishes.
6. Acoustical isolation and attenuation for a nondisruptive environment.	**6.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	
7. Adequate lighting to review entering personnel and monitoring equipment.	**7.** Lighting shall be specially engineered. Low levels of lighting may be required to permit observation of luminous panels without reflected glare or undesirable contrasts in brightness. Separately controlled luminaires shall be provided for normally lighted operations and clean-up; this lighting should have an ambient level of 70 footcandles using fluorescent fixtures.	**7.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical Lighting.
8. Thermal regulation and other comfort features for the occupant.	**8.** Maintain temperature at 68°F (heating) or 78°F (cooling) with a 5 cubic feet per minute per person outside air ventilation rate. A dehumidifier may be required in the armory. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	**8.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
9. Electrical power.	**9.** Provide 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and for every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	**9.** See also Vol 2, SB2, Communication Station Buildings--Electrical.

requirements	criteria	commentary
10. Fire protection/life safety criteria are based on the assumption that this facility houses critical equipment and data that has a severe strategic fire loss potential.	**10.** Interior enclosure walls--2-hour fire-rated construction in armory, security, and entry. Interior doors--1.5-hour fire-rated doors in armory, security, and entry. Interior finish--Class A or B only. Corridor and entry finish--Class A only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**10.** See Standardized Modules-Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety for more information.

guidance



guidance

1. Location

The minimum area is determined from IDS monitoring equipment physical dimensions.

Direct access to facility entrance is required.

This area must have no direct access to C-E equipment.

This component can be combined with the administration function in the small module package.

2. Verification

Orient windows to allow visual security of arriving personnel. In some circumstances, it works well to use mirrors to show the total front face of the building before the door is opened. This also prevents the security officer from confronting unexpected hostile action when leaving.

3. Monitoring

Three shifts in a 24-hour period are assigned for these activities if the personnel are available. At some smaller facilities, the security alarm and detection devices should also be wired into the operations, operations administration, or control monitoring space so that operation shift personnel can monitor the security system when the security space is not staffed.

Alarm system--Provide a wall-mounted alarm terminal panel in the security room. The following alarms will terminate there:

- Smoke/fire detection
- Intrusion detection of all doors and barred openings.

The termination board or its associated housing should have all alarm terminations identified clearly with permanent marking or labels. This allows future extensions of these connections to a control and fault alarm system. The alarm sensors should incorporate only dry contacts (no voltages) and should use two conductor shielded cables in the circuit runs (or in conduit) to the consolidated terminal panel noted above.

Intrusion detection system--The IDS should conform to Corps of Engineers Guide Specification CE 304.01. Provide magnetic intrusion alarm switches on all exterior doors and openings greater than 7.6 feet at the perimeter into the building. Terminate all circuits in the wall-mounted alarm panel. The door alarm is to sound then the door moves 1/2 inch toward an open direction.

guidance

The various approaches to an alarm display problem offer a wide range of capabilities, but also present several distinct disadvantages. In selecting an alarm display system for a specific installation, it is essential that the features and capabilities required for the intended application be well understood. In particular, there is no one "best" system for transmission and display of security information. Rather, a system should be selected to meet the needs of the specific installation. It should also be noted that many systems may provide more capability than is needed or desired and that paying for unused features would tend to increase the system's cost. See Vol 2, SB7, Security Systems, for more information.

4. Primary entrance door

The primary personnel entrance door should be secured with a jimmy-proof, deadbolt extension operated by a combination lock in conformance with UL Standard 768 and Military Specification MIL-L-15596. The primary entrance door should also be equipped with panic bolts and a rim with a box mullion in conformance with Federal Specification FF-H-106. The panic bolts should be UL-approved. If required for routine access control, an electrically controlled latch mechanism is authorized for installation. RF emissions should meet the requirements of MIL-STD-461 of Class II-A equipment when applicable. (5) 3-5-9

The personnel entry doors should be the steel, single-swing type with a steel frame. Another option is a door constructed of hollow metal with a 1/8-inch steel plate face.

Personnel entry doors should also be equipped with a "peephole" wide angle lens. Doors should have an inside plate to cover the peephole when it is not in use.

Hinges on both the exterior personnel and equipment doors must be welded to prevent removal of hinge pins if pivots and pins are on the outside.

7. Lighting design

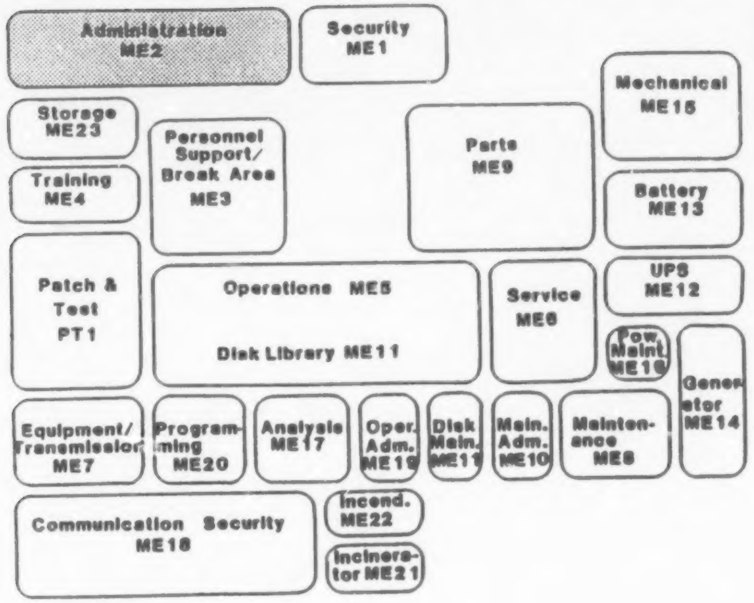
To reduce glare at video digital terminals (VDTs), use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values.

The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On tall ceilings, the cell depth must be greater; this may dictate a larger cell size.

Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

guidance

ADMINISTRATION ME2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Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Incend. ME22
Communication Security ME18
Incinerator ME21

function

This component establishes and maintains the station administrative processing of personnel records. In addition, this section implements written and verbal SOP directives from "Chain of Command" orders, host agency regulations, and DCA policy for DCS. The administration area provides a buffer and transition space between exterior and secure interior spaces.

policy/sop

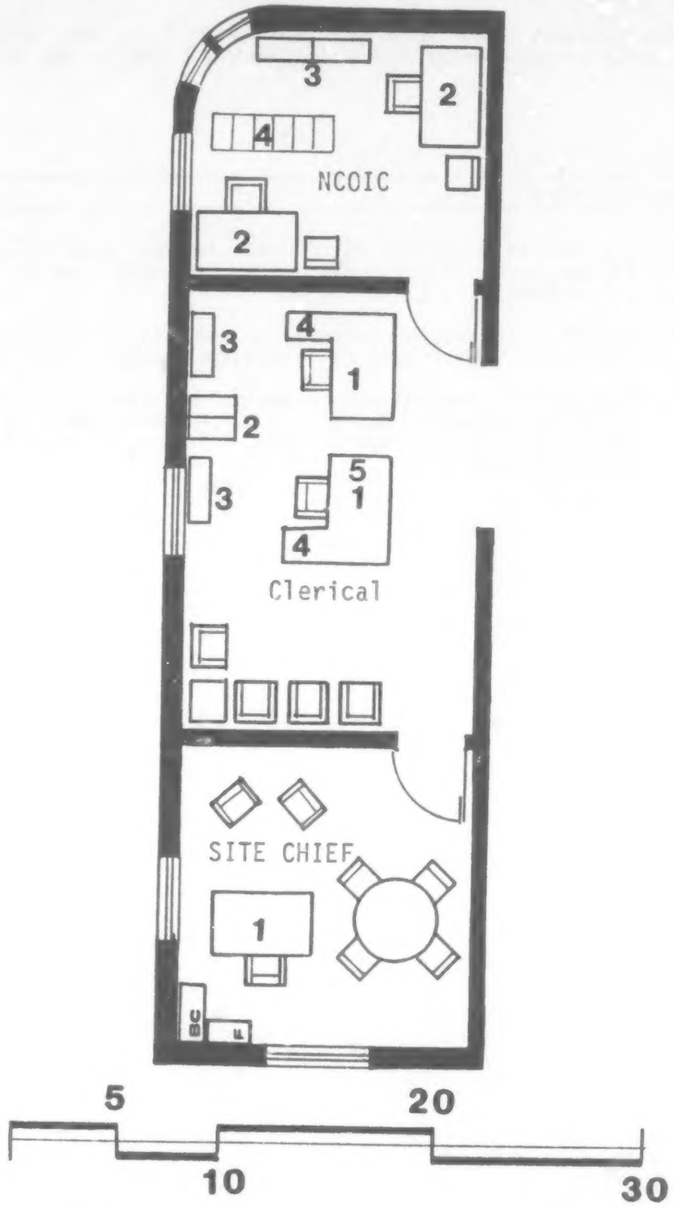
issues and assumptions

activities	personnel	equipment*
Officer-in-charge (OIC) 1. Distributing directives, orders, and policy statements, both written and verbal, to shift supervisors. 2. Initiating evaluation of equipment capabilities. 3. Developing personnel training plans and equipment evaluations.	1. Site chief or OIC. 2. NCOIC and chief-in-charge.	1. Site chief workstation: • Desk/chair (enclosed) • Two side chairs • Credenza. 2. Two NCOIC workstations: Desk/chair in open area (or with dividers). 3. Bookshelves--20 linear feet. 4. Nine files with five drawers each.
Clerical 1. Typing, reception, and coordination of command/control process for the noncommissioned officer in charge (NCOIC). 2. Filing/posting of operations and personnel documents. 3. Providing courier service for paperwork.	1. One E-2 clerk (two at some installations).	1. Clerk workstation: Desk/chair (open area). 2. Two files with five drawers each. 3. Bookshelves--45 linear feet. 4. Typewriter(s)/word processor(s). 5. Operational voice intercom control.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the administrative function.	**1.** Provide administrative space for supervisory personnel. This area varies with the number of assigned personnel, but is typically 700 to 800 square feet.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Carpet. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	**3.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**3.** See reference 201, page 3-4, Table 3-2.
4. Adequate lighting.	**4.** Provide 80 footcandles for task lighting at work surfaces with 40 footcandles for the ambient level. Surface reflectances should be: • Ceilings--80 to 90 percent • Walls--40 to 60 percent • Floor--20 to 40 percent.	**4.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for the occupant.	**5.** Maintain temperature at 68°F (heating), 78°F (cooling), with 5 cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	
6. Electrical power.	**6.** Provide 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppresion--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunicator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location

Windows to the outside are recommended for CONUS facilities on secure sites, such as military installations. OCONUS facilities usually should have a minimum of windows to limit opportunities for forced entry.

Activity subspaces

- Enclosed offices
- Workstations
- Filing area
- Reception.

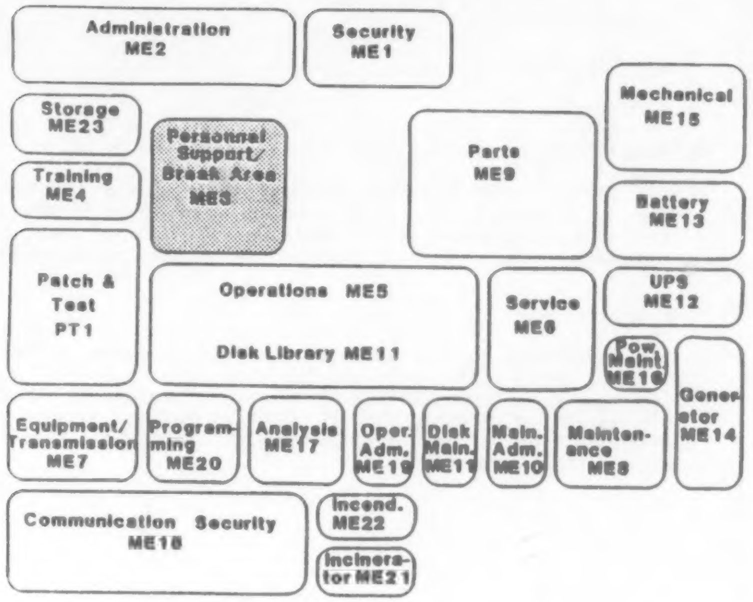
3. Acoustical and visual privacy

Divider partitions between workstations should be 60 inches high (± 4 inches) to provide visual privacy while occupants are seated--and yet should not be confining. Circulation paths around workstations should minimize disturbances to other workstations.

6. Electrical power

Workstation divider partitions can be tackboard surfaces to display maps, job examples, service equipment, and other information. Floor-to-ceiling poles are recommended to distribute electrical and communication lines to workstation modules. This eliminates floor wires at circulation paths and allows future module modifications at minimal cost.

PERSONNEL SUPPORT/BREAK AREA ME3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Oper. Adm. ME19
Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

This component creates a change of environment for on-duty personnel to provide a break from the hard-surface equipment room and work areas.

policy/sop

1. The intense activities in the DCS facility generate personnel fatigue, making it necessary to separate personnel from the communication function.

2. Current policy requires personnel to have a 15-minute break every 3 to 4 hours. Typical schedules also allow 30-minute meal breaks.

3. Most communication personnel "brown bag" their meals since they cannot leave the facility during a shift. Therefore, basic food preparation capability is required: sink, hot plate, refrigerator, cabinets, and range.

issues and assumptions

activities

1. Relaxing.
2. Reading.
3. Eating.
4. Storing food.
5. Preparing food.
6. Storing personal items such as coats and books.

best copy available

personnel

1. Two to eight at once.

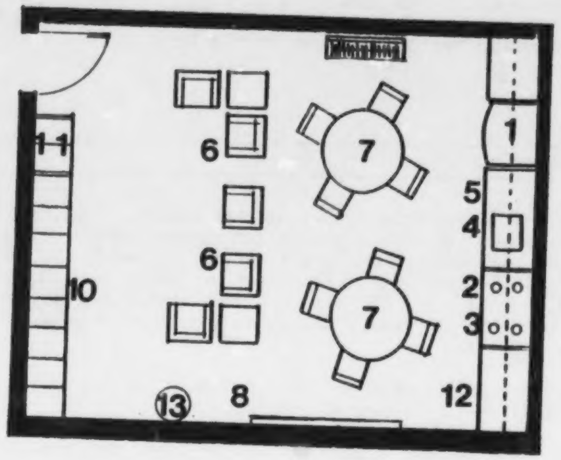
equipment*

1. Refrigerator.
2. Stove.
3. Range and range hood.
4. 20 x 30 inch sink in countertop which is a 6-foot minimum with cabinets above.
5. Coffee machine.
6. Chairs.
7. Table with chairs for eight.
8. Bulletin boards.
9. Intercom speaker.
10. Storage lockers for each person. (Not required for personnel who have private offices.)
11. Coat rack.
12. Microwave oven (if communication equipment is not affected).
13. Trash receptacles.

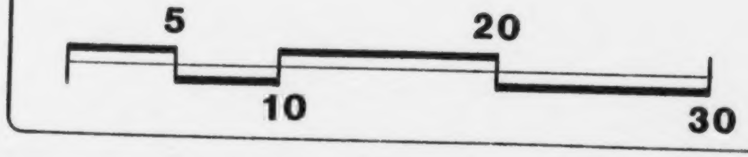
* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the personnel support/break area.	**1.** Provide approximately 500 square feet of space for equipment and furniture to accommodate up to 15 personnel.	
2. Visual separation from the communications equipment.	**2.** Provide visual separation that also allows viewing of the operations area when desired. Supply comfortable furniture and carpeting (earth tones are recommended).	
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Vinyl asbestos tile and area carpeting. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation for a nondisruptive environment.	**4.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	
5. Lighting suitable for reading (task and ambient).	**5.** Use 20 to 30 footcandles for ambient lighting and 100 footcandles for task lighting.	
6. Thermal comfort.	**6.** Control temperature for 68°F (heating) and 78°F (cooling) with a 5-cubic feet per minute per person outside air ventilation rate.	**6.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Provide 120/208 electrical service. 120-volt outlets should be installed for every 10 linear feet of wall. Counter height outlets are required for a coffee maker, mixer, microwave oven (when permitted), and other appliances.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**8.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety for more information.

guidance



9 -- speaker in ceiling



guidance

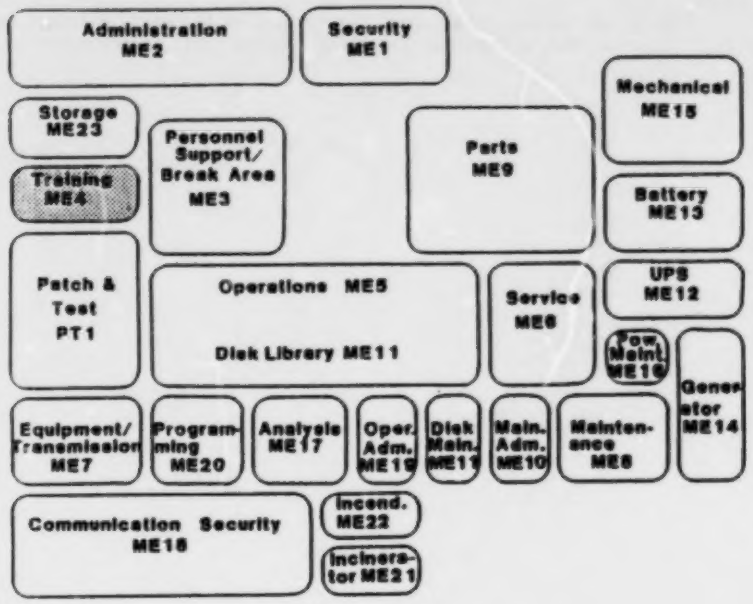
1. Location

The personnel space should be directly adjacent to the operations room, but isolated acoustically (absorptive walls) and visually (a curtain hung at the window).

3. Visual comfort

The color contrast, textures, and designs of the wall, ceiling, and floor surfaces should minimize glare for a comfortable environment.

TRAINING ME4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Incinerator ME21

function

This component is for enhancing personnel abilities and effectiveness, both technically and personally. Development and implementation of the station master training program is done here.

policy/sop

1. Technical training occurs at two levels: (1) hands-on training, i.e., working directly with the communications equipment, and (2) learning from manuals, publications, and audiovisual equipment. The physical training also occurs at two levels: (1) interior individual exercise and (2) exterior small-group recreational activities, especially at remote DCS facilities that are not on a military installation.

2. Current policy requires personnel to be allowed time to train technically while on-duty at the facility.

3. Training usually is done during the times that the communication activity is at its lowest level.

4. Some communications personnel are engaged in a Career Development Course (CDC); thus, a training area is required. The Air Force counterpart is the Quick Training Package (QTP).

5. Training usually is conducted by the shift supervisor or a lead NCO/CO who is also on-duty.

6. In fire/life/safety training, safety implies the absence and/or control of conditions that can cause personal injury, death, damage to, or loss of equipment or property. Within the system, safety is concerned with the elimination or control of factors affecting the safe and efficient operation of personnel, equipment, and facilities organized to attain a common goal. The objective of safety training therefore is to insure maximum freedom from inadvertent and possibly destructive mishaps resulting from facility equipment, procedural, or personnel deficiencies during all phases of system operation. (70) 15-30

issues and assumptions

1. Three-shift versus four-shift impact on training time available

Most facilities operate on a three-shift basis:

• Day shift	8 a.m. to 4 p.m.
• Swing shift	4 p.m. to 12 a.m.
• Midshift	12 a.m. to 8 a.m.

By having personnel assigned to four shifts instead of three, one group could be a "training shift" that would be on duty during the day shift; thus, the peak activity period would have double the personnel available if required, plus give trainees the best opportunity to interact with facility functions.

The four-shift concept, however, assumes one or both of the following:

- More persons will be assigned to the site
- Staffing for the three operating shifts can be reduced.

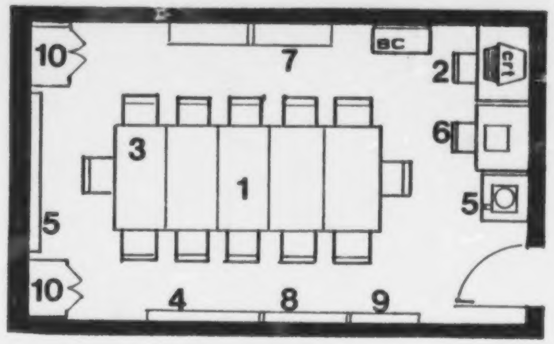
activities	personnel	equipment*
Technical training 1. Observing and evaluating personnel records; conducting personnel interviews to determine training requirements. 2. Developing overall master training plan and presenting special MOS training module program for a specific focus. 3. Studying manuals and other publications. 4. Watching video cassettes, 16-millimeter movies, and slides. 5. Instructing in fire/life/mission safety.	Instructors 1. Commander. 2. NCOIC. 3. Civilian technicians (not an office area for personnel).	Classroom/conference room 1. Table and seating for 12. 2. TV monitor/CRT terminal. 3. Viewgraph projection. 4. Charts and display panels. 5. Audiovisual projection and screens. 6. TEC library monitors. 7. Library of written instructional materials--20 linear feet. 8. Chalkboard. 9. Tackboard for training and information bulletins. 10. Audiovisual equipment storage cabinet. 11. Intercom speaker.
Physical training 1. Involves mandatory military training requirements for physical fitness, weapons qualifications, and CBR training.		Fitness area 1. Exercise equipment: 8 by 4 foot mat, weight set, and exercycle. 2. Exterior area for volleyball and half-court basketball. 3. Athletic and recreational items; balls, bats, horseshoes, etc. 4. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
Technical training		
1. Enough space for small groups (up to 20 people) that meet for small training seminars. Space for reading and studying manuals and other publications associated with the training function.	**1.** Provide 25 square feet of space per person. Equipment layout and storage require additional square footage.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation from the high noise level generated in the operations area.	**3.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**3.** See reference 201, page 3-4, Table 3-2.
4. Flexible lighting.	**4.** Provide adjustable lighting, depending on varied uses. o 20 to 80 footcandles at each work surface. o 10 footcandles at rear of room during audiovisual projection. Surface reflectances should be: o Ceiling: 80 to 90 percent o Walls: 40 to 60 percent o Floor: 20 to 40 percent.	**4.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for occupants.	**5.** Regulate temperature at 68°F (heating), 78°F (cooling) with 5 cubic feet per minute per person outside air ventilation rate. Seating should be adjustable to provide maximal body support comfort for many different sizes.	**5.** See also Vol 2, SB2. Communication Station Buildings--Mechanical.
6. Electrical power.	**6.** Provide 120/208 electrical service. Provide 120-volt outlets--one receptacle for every 10 linear feet of wall. Specific equipment outlets depend on the room layout.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

requirements	criteria	commentary
Physical training		
1. Enough space to allow each person to perform physical exercises and workouts.	**1.** Minimal area of approximately 150 square feet (10 by 15 feet).	

guidance



guidance

1. Location

Since most technical training involves hands-on experience with the communications equipment, the training room should be adjacent to the operations space and should have a view into the operations space if possible.

4. Lighting design

Classroom lighting immediately in front of a lecture platform can be controlled from a point convenient to the speaker's platform and also at the entrance. Lighting can be controlled by motor-operated dimmers from the platform and the main entrance to facilitate use of audiovisual aids. Lighting can also be controlled from those points by switches. Minimum lighting shall be provided so that notes can be taken during the use of visual aids.

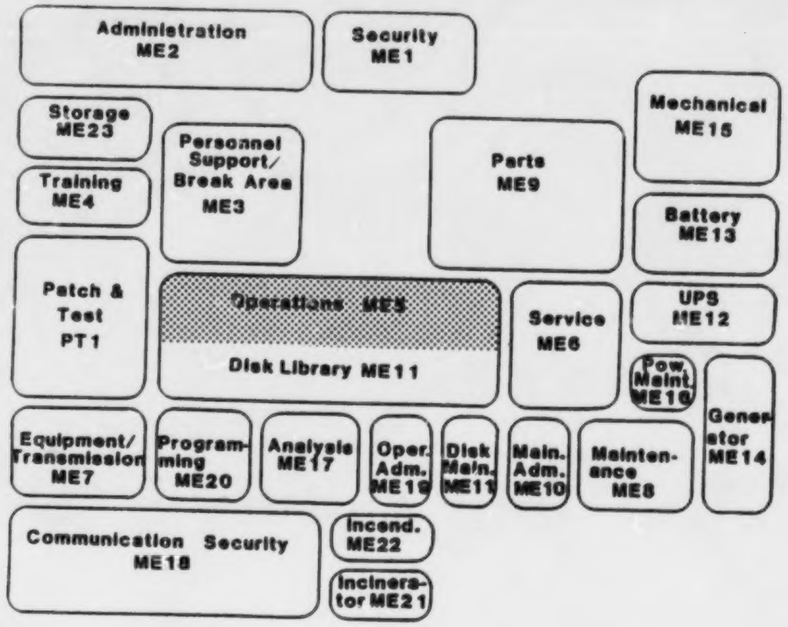
Physical training

See "storage" for interior physical training area guidance drawing.

guidance

guidance

OPERATIONS ME5


Administration ME2
Security ME1
Storage ME23
Training ME4
Personnel Support/ Break Area ME3
Parts ME9
Mechanical ME15
Battery ME13
Patch & Test PT1
Operations ME5
Disk Library ME11
Service ME6
UPS ME12
Pow. Maint. ME16
Generator ME14
Equipment/ Transmission ME7
Programming ME20
Analysis ME17
Oper. Adm. ME19
Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

To provide space that allows personnel to operate, maintain, monitor, and repair communication equipment optimally.

policy/sop

1. Equipment and equipment layout should be standardized as much as possible among the facilities comprising a communications system. In determining the layout when unencrypted signals bearing classified information will be present or processed, the specialized installation guidance in MIL-HDBK-232(C) must be consulted. Another major consideration should be the access necessary for installation, maintenance, and operation. This would include considerations such as providing adequate space between equipment rows to allow for opening cabinet doors or sliding out modules for maintenance. Another major, but less important, consideration is providing the shortest and most direct waveguide run practical. (2) 5-20

2. Other equipment layout considerations include minimizing interbay cabling runs, providing for future expansion, and providing easy access for maintenance and operational convenience. Sometimes the electromagnetic incompatibility of various equipment types or inadequate ventilation for personnel and equipment can cause problems. Equipment of the same type or with similar function usually is grouped together except when impractical because of size and/or specific station requirements. (2) 5-20

3. Equipment should be grouped properly according to function and interoperation. Care should be taken in arranging meters, test equipment, jackfields, indicating lights, etc., to insure they are placed at approximately eye level, thus allowing more rapid, convenient use. Equipment should not be mounted at the bottom of a bay if it can be damaged easily or if its size and shape will interfere with power boxes or other hardware. Most microwave radio equipment comes fully packaged with all components already mounted in the cabinet or rack. (2) 5-21

4. The station's operational plan must be studied when placing each component or rack assembly to determine communication circuit requirements. In small stations, it is recommended that the equipment be aligned in a row along one or, if need be, both sides of the building with enough space in between to accommodate a normal floor traffic pattern. However, this type layout usually will not be suitable in stations with much equipment. In the large station, the most practical layout usually is one in which the equipment is aligned in bays across the width of the room, with enough space between bays to permit free access to each rack assembly. (2) 5-22

issues and assumptions

1. Automated record keeping

CRTs with hardline printers can streamline paperwork by storing all circuit history files on disk. This will allow more rapid troubleshooting in-house.

2. Electromagnetic compatibility (2) 5-43

Electromagentic compatibility (EMC) is a complex subject, so that specialists often must perform the type of EMC study needed to insure the equipment or equipment layout produces no interferences or radiation hazard.

DOD is working on new regulations to control permissible levels of EM pollution of the frequency spectrum. This work reflects the concern for environmental protection. Radiation hazards also are being regulated through concern for occupational safety. Engineering agencies working for the Government must therefore know the legal and regulatory aspects of EMC and radiation hazards to meet these requirements.

Military specifications on EMC such as MIL-STD-461, -462, and -463 are intended to control and achieve an acceptable figure of merit or quality in the development of new communications equipment. They do not eliminate the need for EMC engineering in facility design. In addition to equipment quality, the frequency selection, nearness to other facilities and, to some extent, the facility design itself are variables in the interference generation problem. (2) 5-43

3. Determining the correct shielding procedure

A comprehensive approach to the shielding of equipment from radiofrequency interference (RFI) or TEMPEST involves (a) a building layout to optimize inherent facility shielding conditions, (b) suitable location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components.

See Vol 2, SB4, for additional guidance information.

activities

1. Monitoring communication equipment (patch and test).
2. Isolating fault.
3. Doing quality control maintenance tests.
4. Troubleshooting and patching to good equipment.
5. Identifying bad connections.
6. Writing and typing reports.
7. Conducting training sessions.

personnel

1. OPS NCOIC.
2. Two to six operators.

equipment *

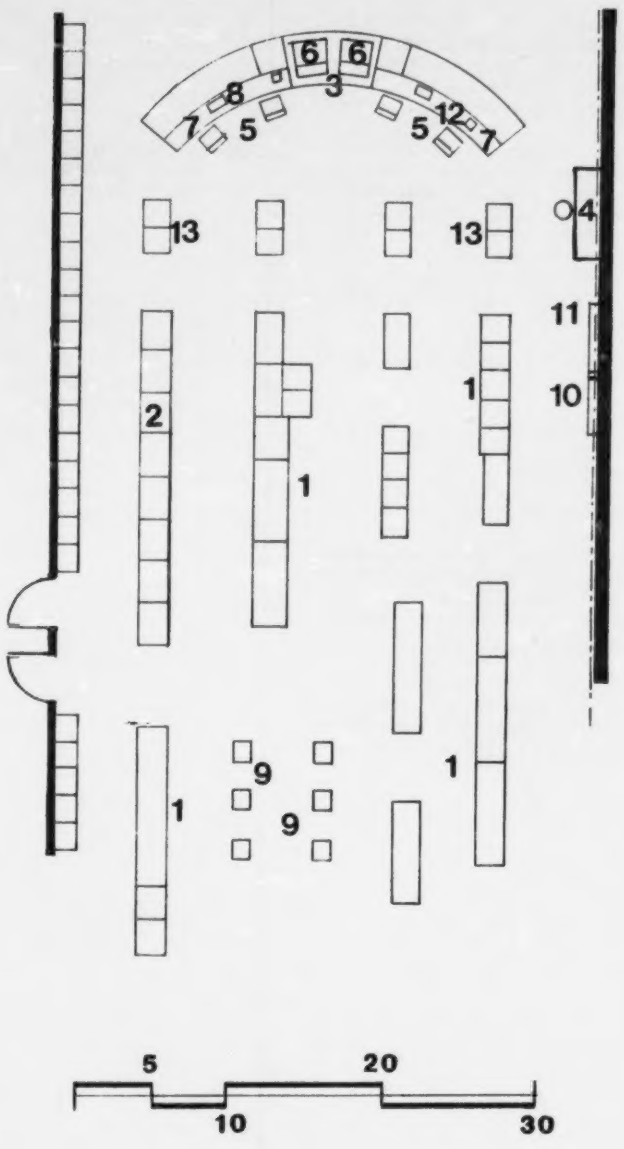
1. Electronic communication system.
2. Patch bays.
3. Control console.
4. Workbench (6 linear feet) with shelving for manuals.
5. Desk with chair.
6. CRT at console.
7. Telephones.
8. Typewriter(s) or word processor(s).
9. Filesafe.
10. Electrical shock first-aid-kit.
11. Alarm panel.
12. Operational voice intercom control.
13. Record file (10 drawers).

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for operating and monitoring C-E equipment and for proper spacing between equipment to facilitate easy maintenance.	**1.** Space varies due to the range of communication equipment designed. See layout in Guidance.	
2. Security for C-E equipment.	**2.** The operations room must be lockable when unstaffed and supplied with an intrusion alarm system. The operations console should be fitted with alarms for intrusion, power failure, and generator status.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Signal shielding.	**3.**	**3.** See Vol 2, SB4, Grounding, Bonding and Shielding, along with SB7, Security Systems, for more information.
4. EMP/HEMP shielding.	**4.** Shielding is necessary for survivability and uninterrupted functioning should the facility be subjected to electromagnetic pulse (EMP) or high-altitude electromagnetic pulse (HEMP). Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	
5. Raised floor system.	**5.** Raised or false floors are necessary for proper cooling of the equipment.	**5.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
6. Interior finishes suitable for durability, maintenance, and room function.	**6.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor that has a dust-on finish containing a hardener. See Vol 2, SB2, Interior Construction. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster and acoustic tiles to within four feet of the floor. Ceiling--Acoustic tile.	**6.** See also Vol 2, SB2, Interior Construction and Finishes.
7. Acoustical isolation/attenuation for variable noise levels produced by electronic equipment.	**7.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile also is required to within 4 feet of the floor.	
8. Adequate lighting.	**8.** Lighting shall be specially engineered. Low levels of lighting may be required to permit observation of luminous panels without reflected glare or undesirable contrasts in brightness. Separately controlled luminaires shall be provided for normally lighted operations and cleaning purposes with an ambient level of 70 footcandles using fluorescent fixtures.	**8.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.

requirements	criteria	commentary
9. Controlled environment for proper operation.	**9.** Maintain 70°F (±2°) and 50 percent relative humidity (± 5 percent continuously. Provide 5 cubic feet per minute per person outside air ventilation rate or the outside air quantity necessary to maintain a room pressurization requirement of .05 to .10 water gage.	**9.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
10. Electrical power.	**10.** Provide 120/128 electrical service and 120-volt outlets--one receptacle for every 10 linear feet of wall. Outlets for equipment should be available under the raised floor as per layout. Electrical power must fall within the 10,000 to 500,000 watt range, with frequency levels at 50 to 60 hertz ± 5 percent.	**10.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**11.** Vaulted enclosure walls--2 hour (minimum) fire-rated, shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area--Automatic fire detection: Local alarm. Automatic Halon 1301 suppression system if required for cross-zoned or matrix detection. Sprinkler and Halon systems are not normally installed in the same areas.	**11.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Equipment expansion

It is advisable to arrange equipment in the equipment room such that future expansion of the building will not necessitate complete rearrangement. (2) 5-21

Approximately 3 feet of clearance space, as a minimum, should be allowed in front of and to the rear of an equipment bay. If a bay does not permit rear access to equipment, the bay can be installed with no clearance on the back side, that is, against a wall or back-to-back with other bays, unless ventilation requirements are compromised. (2) 5-21

5. Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on raised floors for maximal use of coupled air directly through the cabinets. Cooling air at 60°F supplied directly into the base of the transmitters will leave the top at approximately 72°F. Thus, when the air exits the equipment, it is at a more comfortable temperature for persons working in the space.

8. Control area

Light fixtures should provide an approximate uniform lighting intensity of 70 footcandles and should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. Lights over the area in which the control console is located shall be provided with wide-range (100:1) dimming control. (23)12

Equipment area

Fixtures should be arranged above the operating aisles and should run parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so light is not obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23)12 Portable task lighting should also be supplied for the equipment area at 70 to 100 footcandles.

9. Protection from moisture migration

Operating spaces that contain electronic equipment usually require close temperature and humidity control. Vapor barriers placed under floor slabs and roofing usually prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided if exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

guidance

Mechanical

The recommended operating temperatures and humidity conditions should be obtained from the manufacturers of the communications and data processing equipment and should be used in designing the environmental control system.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Inadequate cooling contributes as much to failure as poorly regulated power. (74) 4-17

Even though certain individual units can operate outside the limits of the overall specifications, overall environmental requirements are dictated by the most restrictive unit of the system. The computer system's requirements are the major considerations; however, good design will also consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in the following ways. (74) 4-17

- Heat dissipation by computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The number of air changes per hour varies between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Also, if the air-conditioning requirements are not met, a record must be available to indicate the extent and duration of the undesirable condition and indicate whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-25

guidance

- Insure the air-conditioning system continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is needed when humidity limitations are exceeded. Drying out may be necessary if the excess humidity occurs either during periods of actual operation or while the machine is shut down and unattended. The extent and duration of excessive humidity determines the length of the drying-out period.
- Determine if the environment meets requirements for the machine.

A visual or audible signaling device is desirable in the recording instrument. This is to provide visual or audible indication that temperature or humidity in the computer area is nearing the maximum limit.

Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The recorder is usually located at a representative spot in the room and adjacent to the control devices.

For monitoring underfloor air conditions, a remote indicating instrument is recommended. This is usually a 7-day electric-drive chart and can be the wet-and-dry-bulb or electronic type if direct reading is not available. The recording instrument can be located on the wall in the operations room, in the mechanical equipment room, or in any other location convenient to the building engineer.

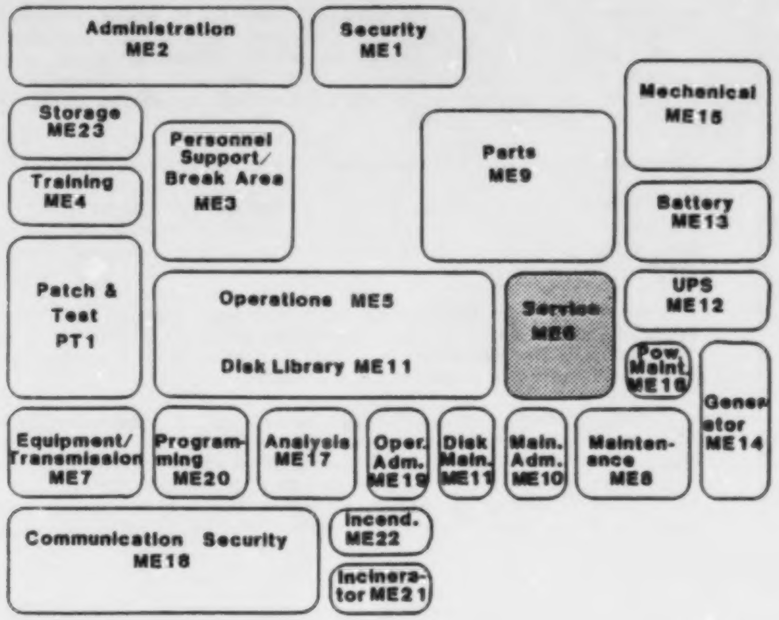
10. Electrical

Consider providing a flexible system that will meet the facility's future requirements. Electronic equipment is constantly being upgraded, modified, and replaced. Bus duct systems and cable trays may prove to be most flexible for areas in which new equipment is expected or that may have frequent modification. (5) 3-4-8

Specifically refer to the "Electrical" portion of "Issues and Assumptions" portion of SB2, Vol. 2, for information relative to host nation power requirements. Additional information may be found in "guidance" of SB2 with respect to the standard frequencies and voltage levels used by various nations.

Provide host nation standard outlets of applicable.

SERVICE ME 6


Administration ME2
Security ME1
Mechanical ME15
Storage ME23
Personnel Support/ Break Area ME3
Parts ME9
Training ME4
Battery ME13
Patch & Test PT1
Operations ME5
Disk Library ME11
Service ME6
UPS ME12
Pow. Maint. ME16
Generator ME14
Equipment/ Transmission ME7
Programming ME20
Analysis ME17
Oper. Adm. ME19
Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

To maintain and monitor records of all DCS communication traffic.

policy/sop

1. Due to the classification level of information generated in the service area, proper security requires this area to be "sanitized" when visiting personnel are permitted access. The same procedure is required at the completion of each shift.

issues and assumptions

activities

1. Delivering printouts to the analysis area.
2. Monitoring the service equipment.

personnel

1. Two or three service personnel.

equipment*

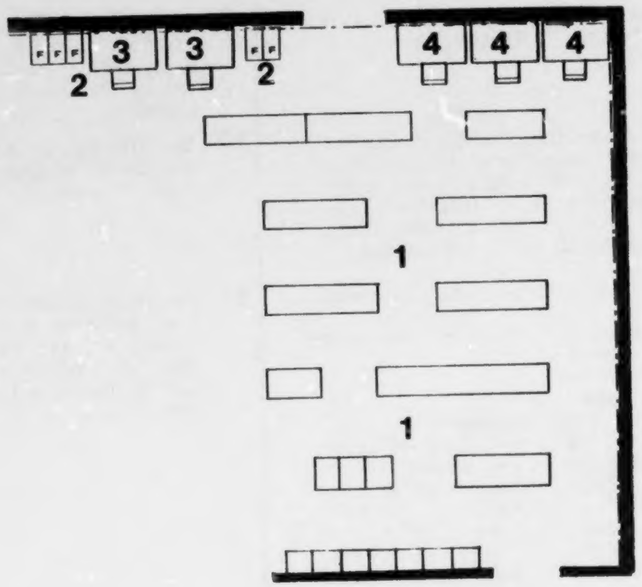
1. Service equipment.
2. Five filesafes.
3. Two desks with chairs.
4. Three tables.
5. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

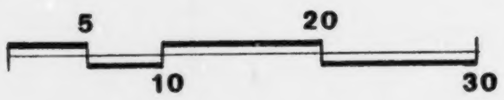
requirements	criteria	commentary
1. Enough space for operating and monitoring service equipment. Equipment must be spaced properly to facilitate workflow and maintenance.	**1.** Varies due to extent of equipment designed. See layout in Guidance.	
2. RFI/TEMPEST shielding.	**2.** Electrical and electronic equipment must be shielded to prevent it from propagating interference and to protect it from the effects of interference propagated by other electronic devices. (15a) 7 The term "TEMPEST" flags the system as processing national security-related information and establishes the need for additional, site-specific facility alterations and improvements.	**2.** See Vol 2, SB4, Grounding, Bonding and Shielding, along with SB7, Security Systems, for more information.
3. EMP/HEMP shielding.	**3.** Shielding is necessary for survivability and uninterrupted functioning when the facility is subjected to electromagnetic pulse (EMP) and high-altitude electromagnetic pulse (HEMP). Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	**3.** See Vol 2, SB5, EMP/HEMP Protection, for more information.
4. Equipment security.	**4.** Install curtain covers on overhead rods to provide rapid sanitizing of service area.	
5. Raised floor system.	**5.** Raised or false floors are necessary for proper cooling of the equipment.	**5.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
6. Interior finishes suitable for durability, maintenance, and room function.	**6.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor that has a dust-on finish containing a hardener. See Vol 2, SB2, Interior Construction. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls-Paint over concrete, gypsum board, or plaster and acoustic tiles to within four feet of the floor. Ceiling--Acoustic tile.	**6.** See also Vol 2, SB2, Interior Construction and Finishes.
7. Acoustical isolation for variable noise levels produced by electronic equipment.	**7.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (mininmum) and floor surface at NRC .25 (minimum). Acoustic tile is also required to within 4 feet of the floor.	
8. Environmental control for proper operation of electronic equipment.	**8.** Temperature should be maintained at 70°F (±2°) with 50 percent relative humidity (±5 percent) continuous. Provide for 5 cubic feet per minute per person outside air ventilation rate or an outside air quantity necessary to maintain a room pressurization requirement of .05 to .10 water gage.	**8.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.

requirements	criteria	commentary
9. Adequate lighting.	**9.** Ambient: 20 footcandles with fluorescent fixtures. Task (testing and inspection): 70 footcandles.	**9.** For further information on lighting design quality using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
10. Electrical power.	**10.** Provide 120/208 electrical service. Receptacles (120-volt) should be located for convenience at each workstation and workbench at the appropriate height and/or for every 10 linear feet of wall. Electrical power must fall within the 10,000- to 500,000-watt range, with frequency levels at 50 to 60 hertz ± 5 percent.	**10.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that would create a severe strategic fire loss potential.	**11.** Vaulted enclosure walls: Shielded, 2-hour (minimum) fire-rated construction. Interior doors in vaulted walls: 1½-hour fire-rated doors; shielded doors and frames. Interior finish: Class A or B only. Automatic fire detection: Local alarm Automatic fire suppression: Water sprinklers Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Install manual emergency equipment power shut-off at exits. Under raised floor area: Automatic fire detection--local alarm. Automatic Halon 1301 suppression system if cross-zoned or matrix detection is required. Sprinkler and Halon systems usually are not installed in the same area.	**11.** See Standardization Modules, Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



5 -- speaker in ceiling



guidance

5. Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on a raised floor system for maximum use of coupled air directly through the cabinets. Cooling air at 60°F supplied directly into the transmitters' base will leave at the top at approximately 72°F. Thus, air exiting the equipment is at a more comfortable temperature for personnel working in the space.

8. Protection from moisture migration

Operating spaces that contain electronic equipment usually require careful temperature and humidity control. Vapor barriers under floor slabs and incorporated into roofing usually will prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided where exterior walls form part of the equipment space. (92) 12.1-13

See also Vol 2, SB2, Special Mechanical.

9. Control area

Light fixtures should provide an approximate uniform lighting intensity of 70 footcandles and should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. Lights over the area in which the control console is located shall be provided with a wide-range (100:1) dimming control. (23) 12

Equipment area

Fixtures should be arranged above the operating aisles and should run parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and they should not be obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23) 12 .Portable task lighting (70 to 100 footcandles) also should be supplied in the equipment area.

guidance

Mechanical

Recommended operating temperatures and humidity conditions should be obtained from manufacturers of the communications and data processing equipment and should be used in designing the environmental control system.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Lack of adequate cooling contributes as much to failure as does inadequately regulated power. (74) 4-17

Even though certain individual units can be operated outside the limits of the overall specifications, the system's environmental requirements are dictated by its most restrictive unit. The computer's requirements are the major considerations in designing the air-conditioning system. However, good design must also consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning as follows: (74) 4-17

- Heat dissipation by the computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity, because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The air changes per hour number between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain conditions required in the computer room. However, introducing water vapor into the airstream for humidification is not recommended in electronic equipment areas because water vapor can damage the equipment. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. If air-conditioning requirements should not be met, a record is available to indicate the extent and duration of the undesirable condition and to indicate if a drying-out period is required. This record may, in some cases, save machine shutdown time. (74) 4-25

guidance

The temperature and humidity records can be used to: (74)4-25

- Insure that the air-conditioning installation continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is necessary when humidity limitations have been exceeded. The drying-out may be needed if the excess humidity occurs either during actual operation or when the machine is shut down and unattended. The extent and duration of the excess humidity will determine the length of the drying-out period.
- Determine if the environment in the area meets the machine's requirements.

It is desirable that the instrument include a visual or audible signal to indicate when the temperature or humidity in the computer area is nearing maximum limits.

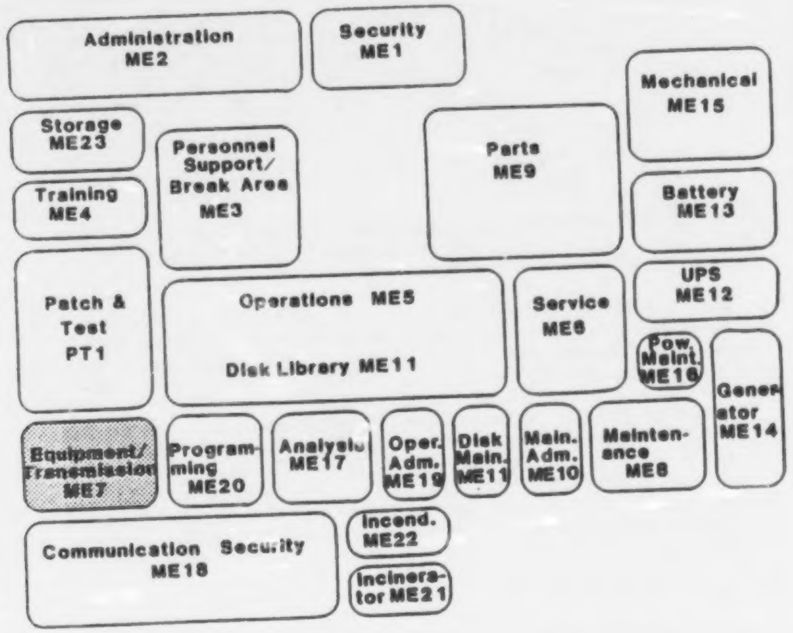
Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The recorder usually is located at a representative spot within the room and adjacent to the control devices.

A remote indicating instrument is recommended for monitoring underfloor air conditions. This is usually a 7-day electric-drive chart and can be the wet and dry bulb or electronic type if a direct reading device is not available. The recording instrument can be located on the wall in the room, in the mechanical equipment room, or at any other location convenient to the building engineer.

10. Electrical

Consideration should be given to providing a flexible system that will meet the facility's future requirements since electronic equipment is constantly upgraded, modified, and replaced. Bus duct systems and cable traps may provide the best flexibility in areas where new equipment is expected or where frequent modification may occur. (5) 3-4-8.

EQUIPMENT ME7


Administration ME2
Security ME1
Mechanical ME15
Storage ME23
Personnel Support/ Break Area ME3
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Battery ME13
UPS ME12
Patch & Test PT1
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Pow. Maint. ME16
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Programming ME20
Analysis ME17
Oper. Adm. ME19
Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Incend. ME22
Communication Security ME18
Incinerator ME21

function

To provide space for the modems used to transmit DCS message traffic. (Facility patch-and-test activities are interrelated with this equipment.)

policy/sop

issues and assumptions

1. Automated recordkeeping

CRTs with hardline printers can streamline paperwork by storing all circuit history files on disk. This will allow much more rapid troubleshooting inhouse.

2. Electromagnetic compatibility (2) 5-43

Electromagnetic compatibility (EMC) is a complex subject and specialists usually must perform the type of EMC study needed to insure that the equipment or its layout produces no interferences or radiation hazard.

DOD is working on new regulations to specify permissible levels of EM pollution of the frequency spectrum. This effort reflects the concern for environmental protection. Radiation hazards also are being regulated through concern for occupational safety. Engineering agencies involved in military construction must therefore know the legal and regulatory aspects of EMC and radiation hazards to meet the requirements.

Military specifications on EMC, such as MIL-STD-461, -462, and -463 are intended to control and achieve an acceptable figure of merit or quality in the development of new communications equipment. They do not eliminate the need for EMC engineering in facility design. In addition to equipment quality, the frequency selection, nearness to other facilities and, to some extent, facility design itself are variables in the interference generation problem. (2)5-43

3. Determining the correct shielding procedure

A comprehensive approach to shielding equipment from radiofrequency interference (RFI) or TEMPEST involves (a) a building layout to optimize inherent facility shielding conditions, (b) suitable location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components.

See Vol 2, SB4, for additional guidance.

activities

1. Operating transmission equipment and console.
2. Testing and maintaining transmission equipment.
3. Receiving and processing outage reports.
4. Logging in transmission data.
5. Recording maintenance work.
6. Conducting training sessions at console.

personnel

1. Two shift personnel.

equipment *

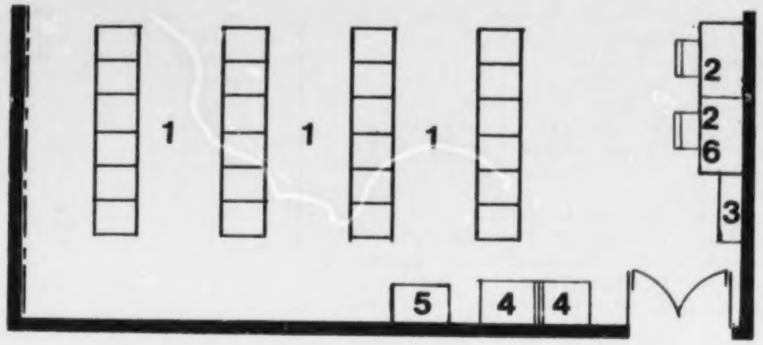
1. Transmission equipment.
2. Two desks with chairs.
3. Bookshelves for manuals (20 linear feet).
4. Carts for equipment.
5. Filesafe, five drawers.
6. Telephones.
7. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for transmission equipment layout.	**1.** Provide approximately 450 square feet in an area 15 x 30 feet to accommodate the transmitter bays.	
2. Enough space to accommodate communication equipment inspection, testing, and storage.	**2.** Allow a 48-inch workspace behind all radio equipment for inspection, testing, and repair.	
3. RFI shielding.	**3.** Electrical and electronic equipment must be shielded to prevent it from propagation interference and to protect it from the effects of interference propagated by other electronic devices. (15a) 7	**3.** See Vol 2, SB4, Grounding, Bonding, and Shielding, along with SB5, EMP/HEMP Protection.
4. Raised floor system.	**4.** Raised or false floors are necessary for proper cooling of the equipment.	**4.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
5. Interior finishes suitable for durability, maintenance, and room function.	**5.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor that has a dust-on finish containing a hardener. See Vol 2, SB2, Interior Construction. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster and acoustic tiles to within four feet of the floor. Ceiling--Acoustic tile.	**5.** See also Vol 2, SB2, Interior Construction and Finishes.
6. Acoustical isolation/attenuation for variable noise levels produced by electrical equipment.	**6.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile is also required to within 4 feet of the floor.	
7. Adequate lighting.	**7.** Ambient: 20 footcandles. Task (testing and inspection): 70 to 100 footcandles.	
8. Environmental control for proper operation of electronic equipment.	**8.** Temperature should be maintained at 73°F (+2°), with 50 percent relative humidity (+5 percent). Filtered air in transmission area. (See MIL-HDBK-411A.)	**8.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
9. Electrical power.	**9.** Provide 120/208 electrical service. Electrical power may fall within the 10,000- to 50,000-watt range. Voltages are required to be 50 to 60 hertz ± 5 percent. Install a 120-volt outlet for every 10 linear feet of wall and as required for coordination with equipment.	**9.** See also Vol 2, SB2, Communication Station Buildings--Electrical.

requirements	criteria	commentary
10. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that would create a severe strategic fire loss potential.	**10.** Vaulted enclosure walls: Shielded, 2-hour (minimum) fire-rated construction. Interior doors in vaulted walls: 1½-hour fire-rated doors; shielded doors and frames. Interior finish: Class A or B only. Automatic fire detection: Local alarm Automatic fire suppression: Water sprinklers Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area: Automatic fire detection--local alarm. Automatic Halon 1301 suppression system if cross-zoned or matrix detection is required. Sprinkler and Halon systems usually are not installed in the same areas.	**10.** See Standardized Modules, Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



7-- speaker in ceiling

guidance

4. Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on a raised floor system for maximum use of cooled air directly through the cabinets. Cooling air at 60°F supplied directly into the transmitters' base will leave at the top at approximately 72°F. Thus, air exiting the equipment is at a more comfortable temperature for personnel working in the space.

7. Equipment area

Fixtures should be arranged above the operating aisles running parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so they will not be obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interefere with access to cable trays or equipment. (23) 12 Portable task lighting (70 to 100 footcandles) also should be supplied in the equipment area.

8. Protection from moisture migration

Operating spaces containing electronic equipment usually require careful temperature and humidity control. Vapor barriers under floor slabs and incorporated into roofing usually can prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided where exterior walls form part of the equipment space. (92) 12.1-13

See also Vol 2, SB2, Special Mechanical.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Lack of adequate cooling contributes as much to failure as does inadequate regulated power. (74) 4-17

Even though certain individual units can be operated outside the limits of the overall specifications, the system's environmental requirements are dictated by its most restrictive unit. The computer's requirements are the major considerations in designing the air-conditioning system. However, good design will also consider personnel comfort. (74) 4-17

guidance

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning as follows: (74) 4-17

- Heat dissipation by the computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity, because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The air changes per hour number between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain conditions required in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because the water vapor can damage the equipment. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Should the air-conditioning requirements not be met, a record is available that shows the extent and duration of the undesirable condition and to indicate if a drying-out period is required. This record may, in some cases, save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-25

- Insure that the air-conditioning installation continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is necessary when humidity limitations are exceeded. The drying-out may be needed if the excess humidity occurs either during actual operation or when the machine is shut down and unattended. The extent and duration of the excess humidity will determine the length of the drying-out period.
- Determine if the environment in the area meets the machines' requirements.

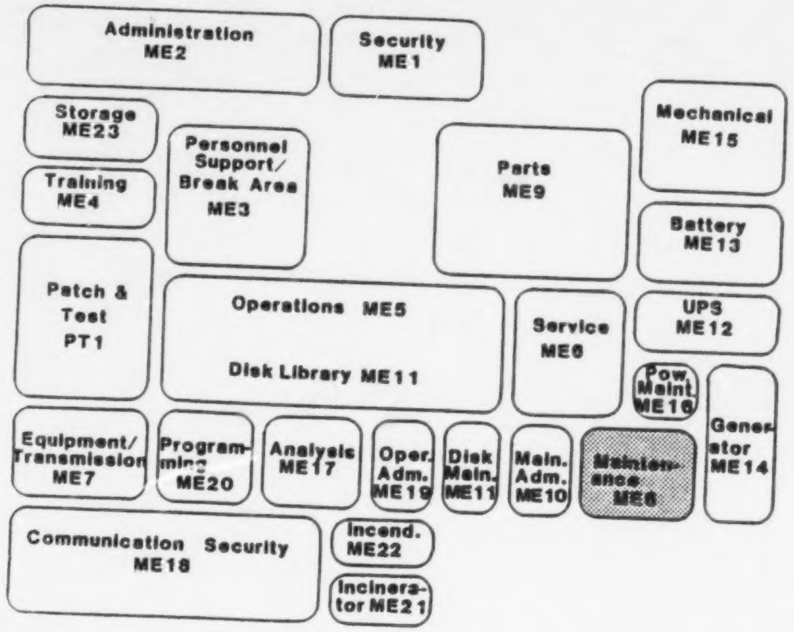
It is desirable that the instrument have a visual or audible signal to indicate when the temperature or humidity in the computer area is nearing maximum limits.

guidance

Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The record usually is located at a representative spot in the room and adjacent to the control devices.

A remote indicating instrument is recommended for monitoring the underfloor air conditions. This is usually a 7-day electric-drive chart and can be the wet and dry bulb or electronic type if a direct reading device is not available. The recording instrument can be located on the wall in the room, in the mechanical equipment room, or at any other location convenient to the building engineer.

MAINTENANCE ME8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Communication Security ME18
Incend. ME22
Incinerator ME21

function

To support assigned personnel and the shift supervisor who repair, clean, and test communication equipment.

policy/sop

1. It is desirable to provide a separate maintenance room for repair activities and the associated test equipment and tools. The space required will, of course, depend on the amount of electronic communication equipment installed, the number of maintenance personnel involved, and the spare parts' stocking requirements.

2. To test and service a microwave communications system properly, maintenance personnel should have a thorough understanding of the equipment's physical makeup, operational characteristics, capabilities, and limitations, and should be familiar with the circuit theory of operation. Equally important is that the proper test equipment be available to these personnel. As the extent of maintenance progresses from onsite field to depot maintenance, the amount and requirements of test equipment needed to perform these procedures will increase, demanding improved facility responsiveness. (70) 7-51

issues and assumptions

activities

1. Inspecting and diagnosing equipment and parts.
2. Completing preventive and unscheduled maintenance.
3. Assembling electronics.
4. Testing electronics.
5. Securing storage of parts and equipment.
6. Maintaining records on parts and equipment.
7. Writing and typing reports, PMI 349's, and equipment historical records.
8. Developing maintenance personnel training plans and equipment evaluations.

personnel

1. Two or three maintenance specialists.
2. Maintenance NCOIC.

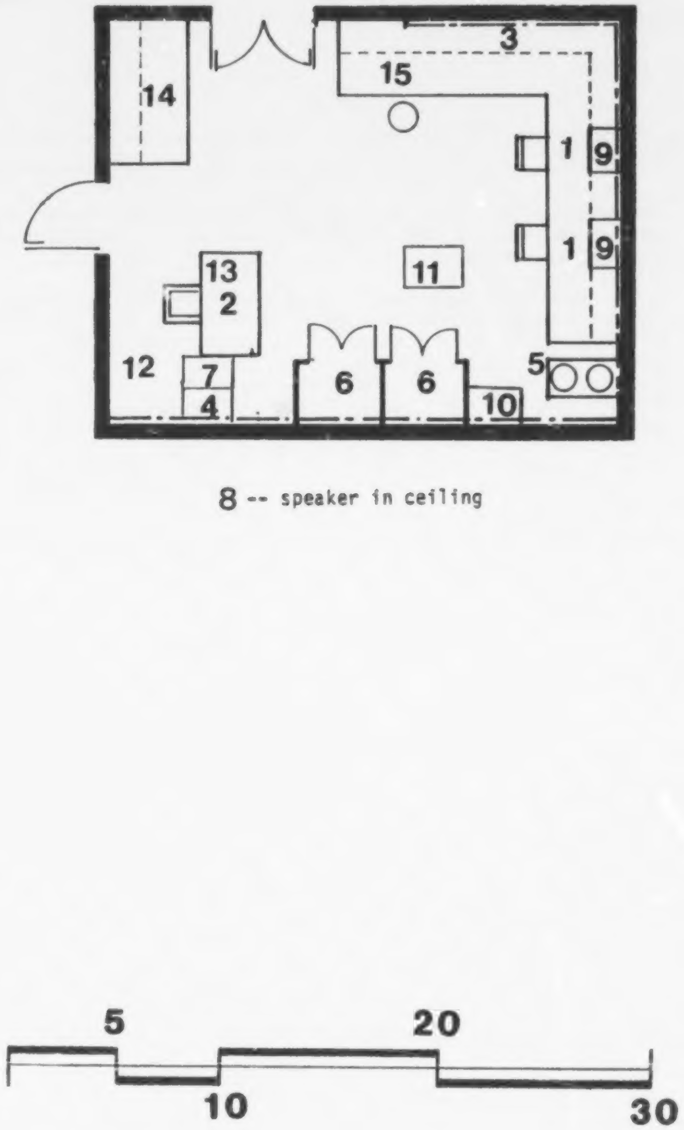
equipment *

1. Two electronic workbenches with stools.
2. Two desks with chairs, one with a typing stand.
3. Shelving over workbench for publications.
4. File cabinet.
5. Portable vacuum cleaner to clean equipment parts. If compressed air blower unit is supplied instead, use 30 pounds per square inch maximum to prevent damage to parts. (Use with a dust collector.)
6. Locked storage cabinets secured to wall for special electronic equipment.
7. Typewriter or word processor.
8. Intercom speaker.
9. Wall-mounted test equipment over workbench.
10. Portable power supply test set.
11. Two scope carts.
12. Multiboard (24 by 48 inches).
13. Telephone.
14. Shelving for inactive equipment storage.
15. CRT terminal.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for inspection, disassembly, and reassembly of sensitive electronic equipment. Space must also accommodate administrative, tool, and part needs.	**1.** Provide approximately 500 square feet.	
2. A secure, controlled area.	**2.** The room should be lockable when unstaffed.	**2.** See Vol 2, SB7, Security (Zone 3) for more information.
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation to eliminate C-E equipment noise to help personnel concentrate when they work on electronic components.	**4.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC. 90, floor surface at NRC .50, and divider partitions (if used) at .85.	
5. Adequate lighting.	**5.** Fixtures should provide 70 footcandles for ambient lighting and 150 footcandles for task lighting.	**5.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical Lighting.
6. Thermal regulation and other comfort features for occupants.	**6.** Regulate temperature at 68°F (heating), 78°F (cooling), with a 5-cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adustment, casters, swivel, and independent backrest adjustment.	**6.** See Also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Install 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height for every 10 linear feet of wall. Provide four duplex outlets at each workbench. All equipment and workbenches must be grounded. Frequency levels should be 50 to 60 hertz ± 5 percent.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**8.** Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance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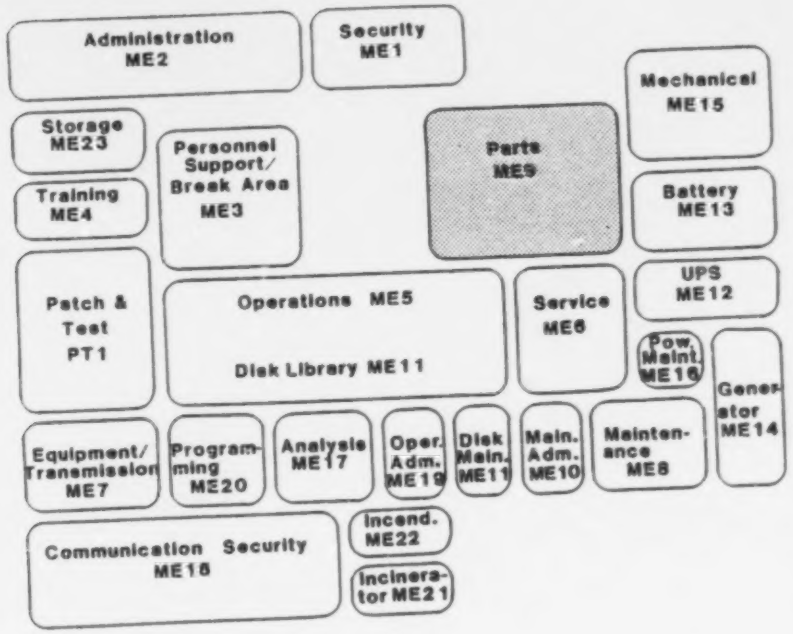
8 -- speaker in ceiling

guidance

PARTS ME9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Incend. ME22
Incinerator ME21

function

To allow space for managing all parts supply operations: ordering, receiving, storage, inventory, and security.

policy/sop

1. Requirements for spare parts storage space are determined by the type of equipment in the installation and the maintenance level to be performed onsite.

2. During preventive maintenance inspections, it will be noted from time to time that some components' performance has deteriorated. Rather than wait for the component to become weaker or to fail completely and interrupt the system, it is considered good maintenance practice to replace weak components during the inspection. Thus, although components are replaced before their full service life has been realized, service interruptions can be avoided. This practice will, in turn, increase the expected replacement parts cost for an operating system; however, the increase is justified on the basis of increased system reliability and the savings in additional manpower costs that would be incurred through the special rush trips to unattended stations needed to restore station operation. (70) 7-49

issues and assumptions

activities

1. Developing parts order lists and working with station Central Supply Office.
2. Receiving, unpacking, shelving of prescribed load list and facility supply parts.
3. Packing and shipping repairable items.

personnel

1. One supply specialist.

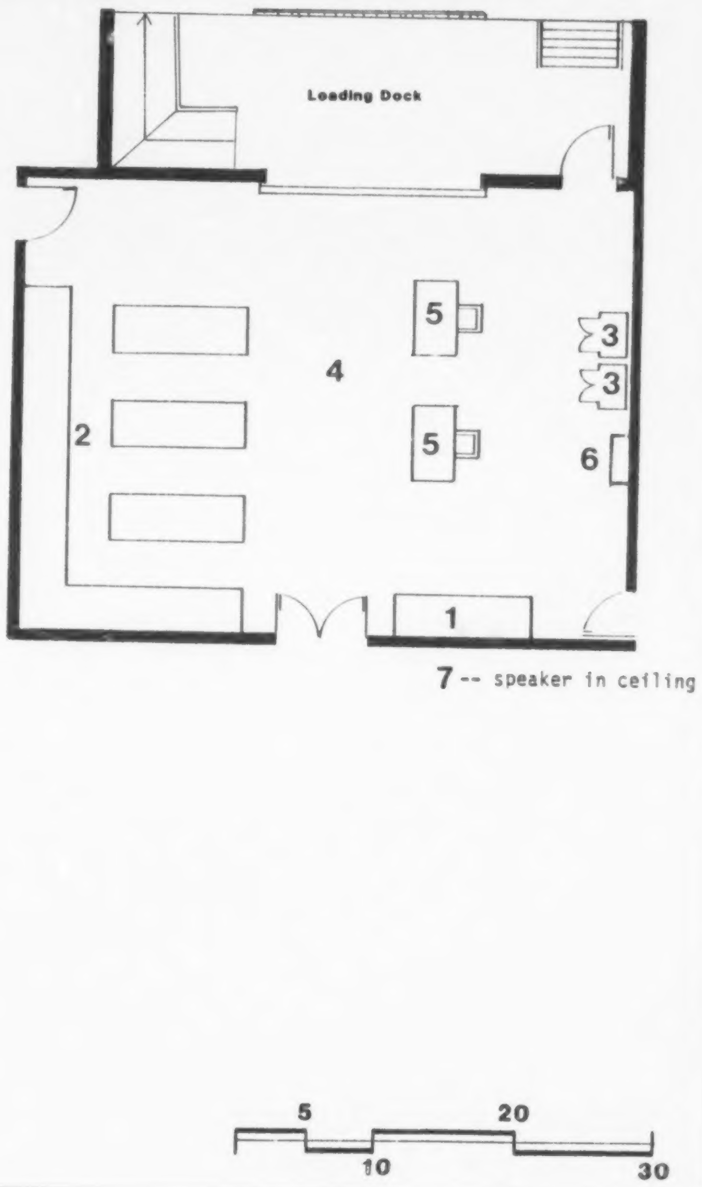
equipment *

1. Table (30 by 60 inches) with chair.
2. Shelving--30 linear feet, floor-to-ceiling type.
3. Three locked cabinets (24 by 36 inches).
4. Open area (100 square feet) for unpacking orders.
5. Desk with chair for parts ordering, microfiche unit.
6. Bookcase for supply manuals--3 to 4 linear feet.
7. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for ordering, receiving, and storing C-E equipment. Space must include an open area to facilitate easy receiving of large equipment and supply orders.	**1.** Provide approximately 1000 square feet to accommodate storage shelves and to leave an open area for receiving shipments of parts and supplies.	
2. A secure environment.	**2.** This area must be lockable when unstaffed. Provide an intrusion alarm system.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation: Acoustical comfort for a nondisruptive environment.	**4.** Adjacent room walls should limit sound transmission to 40 decibels.	
5. Adequate lighting.	**5.** Lighting should be: 20 footcandles (ambient) and 70 footcandles (task).	
6. Environmental control for proper storage of electronic equipment.	**6.** Regulate temperature at 68°F (heating), 78°F (cooling), with a 5-cubic feet per minute per person outside air ventilation rate.	**6.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Supply 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and for every 10 linear feet of wall. Required frequency levels are 50 to 60 hertz ± 5 percent.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**8.** Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location

Locate the parts area between the exterior receiving dock and the maintenance room.

Provide an open area for unpacking equipment before it is moved into operation or equipment rooms.

A loading dock should be designed for a minimum load of 250 pounds per square foot and should provide enough room to maneuver equipment.

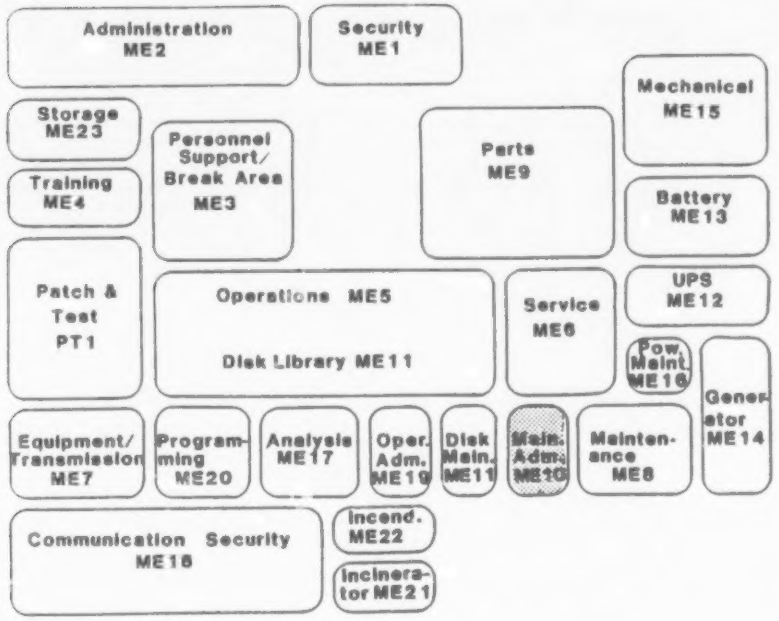
2. Door security

Maintenance/utility doors not permitting entry to administrative/-operational spaces should be secured with heavy cylindrical case lock and latch sets in conformance with Federal Specification FF-H-106 and with Builders Hardware Manufacturers Association Standard 601. Doors and hatches that are externally accessible and lead to critical utilities should be secured with padlocks and hasps in conformance with Military Specification MIL-P-43607 instead of or in addition to the cylindrical case or bored locksets specified above. (5) 3-5-9

The hardware set for secure doors should be:

- 1/8-inch-thick drill-resistant hard plate for inside of door
- Secured-type hinges
- Cypher lock with an electronic access control, electric strike, and emergency battery standby
- Combination lock
- Door closer (on each leaf if pair door is required)
- Wide-angle peephole
- Foot bolts and pull-chain bolt for inactive leaf of pair doors.

MAINTENANCE ADMINISTRATION ME10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Incinerator ME21

function

To provide space that specifically supports the equipment maintenance activities of component trouble analysis and replacement.

policy/sop

1. Maintaining communication equipment requires that specific information be logged into maintenance reports, specifying type of work done, equipment used, equipment history, and parts used (inventory).

issues and assumptions

I. Automated equipment information

Upgrading the system through in-house labor would help develop maintenance personnel responsiveness. CRT's maintenance is a major function at communication facilities; therefore, large quantities of information are generated. An automated records system is needed for:

- Equipment histories (for quality control).
- Automated parts inventory.
- Manuals and specifications.
- Fault isolation for maintenance work by familiarity with the proper procedures.

activities

1. Keeping records of maintenance activity (maintenance logs).
2. Typing.
3. Filing.
4. Specification checking.
5. Parts inventory.
6. Developing maintenance personnel training plans and equipment evaluations.

personnel

1. Maintenance noncommissioned officer in charge (NCOIC).
2. Lead maintenance NCOIC. (where applicable)

equipment *

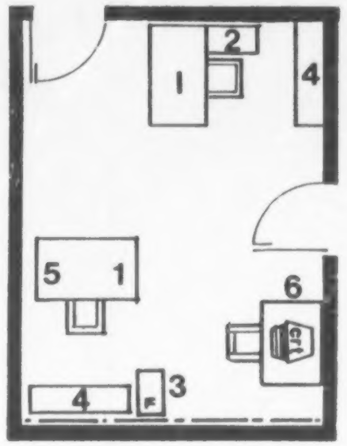
1. One desk with chairs.
2. Typewriter/word processor and stand.
3. File cabinet.
4. Shelving for manuals.
5. Telephone.
6. CRT terminal.
7. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

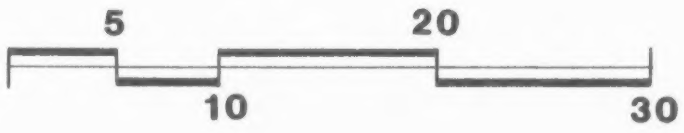
requirements	criteria	commentary
1. Enough space to accommodate the equipment and furniture associated with the administrative function.	1. Provide 120 square feet of enclosed administrative space.	
2. RFI/EMP/HEMP shielding.	2. The functional relationship of maintenance administration to the operations room may require maintenance administration to be included in the shielded/vaulted area. When this is the case, shielding is required in electrical and electronic equipment to prevent interference propagation and to protect the equipment from the interference propagated by other electronic devices. (15a) 7	2. See Vol 2, SB4, Grounding, Bonding, and Shielding, along with SB5, EMP/HEMP, for more information.
3. Interior finishes suitable for durability, maintenance, and room function.	3. Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor with a dusted-on finish that contains a hardener. See Vol 2, SB2, Interior Construction. (Only when included in the vault area.) Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	3. See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation for a nondisruptive environment.	4. The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .90, floor surface at NRC .50, and divider partitions (if used) at .85.	4. See reference 201, page 3-4, Table 3-2.
5. Adequate lighting.	5. General lighting--20 to 50 footcandles. Task lighting--70 to 150 footcandles, adjustable arms. VDT--5 to 50 footcandles (when applicable). Surface reflectances: Ceiling--80 to 90 percent. Walls--30 to 80 percent (wall at person's back should be 10 to 20 percent). Floor--15 to 40 percent.	5. For further information on lighting design quality using the ESI concept, see Vol 2, SB2, Electrical Lighting.
6. Thermal regulation and other comforts for occupants.	6. Temperature regulation should provide 68°F (heating), 78°F (cooling), with a 5-cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	6. See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	7. Install 120/208 electrical service. Receptacles (120-volt) should be located for convenience at each workstation at a suitable height for every 10 linear feet of wall. Electrical power must fall within the 10,000- to 500,000-watt range. Frequency levels must be at 50 to 60 hertz ± 5 percent.	7. See also Vol 2, SB2, Communication Station Buildings--Electrical.

requirements	criteria	commentary
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**8.** Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Vol 2, Standardized Modules--Building Design Principles, and SB3. Fire Protection/Life Safety, for more information.

guidance



7-- speaker in ceiling



guidance

4. Lighting design

To reduce glare at video digital terminals (VDTs), use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values.

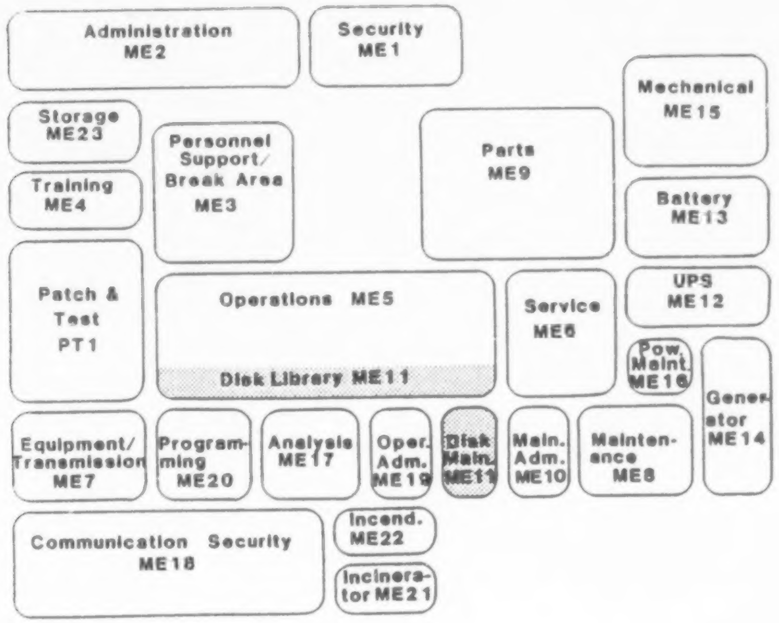
The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On tall ceilings, the cell depth must be greater; this may dictate a larger cell size.

Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

guidance

guidance

DISK LIBRARY/MAINTENANCE ME11


Administration ME2
Security ME1
Mechanical ME15
Storage ME23
Personnel Support/ Break Area ME3
Parts ME9
Training ME4
Battery ME13
Patch & Test PT1
Operations ME5
Disk Library ME11
Service ME6
UPS ME12
Pow. Maint. ME16
Generator ME14
Equipment/ Transmission ME7
Programming ME20
Analysis ME17
Oper. Adm. ME19
Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

To provide a secure storage for movable head disks and magnetic tapes. To serve as software library and maintenance/cleaning workstation.

policy/sop

1. Current policy is to have a separate, secure storage space with temperature and humidity levels maintained constant.

issues and assumptions

activities

1. Storing disks.
2. Retrieving disks.

personnel

1. One or two as required.

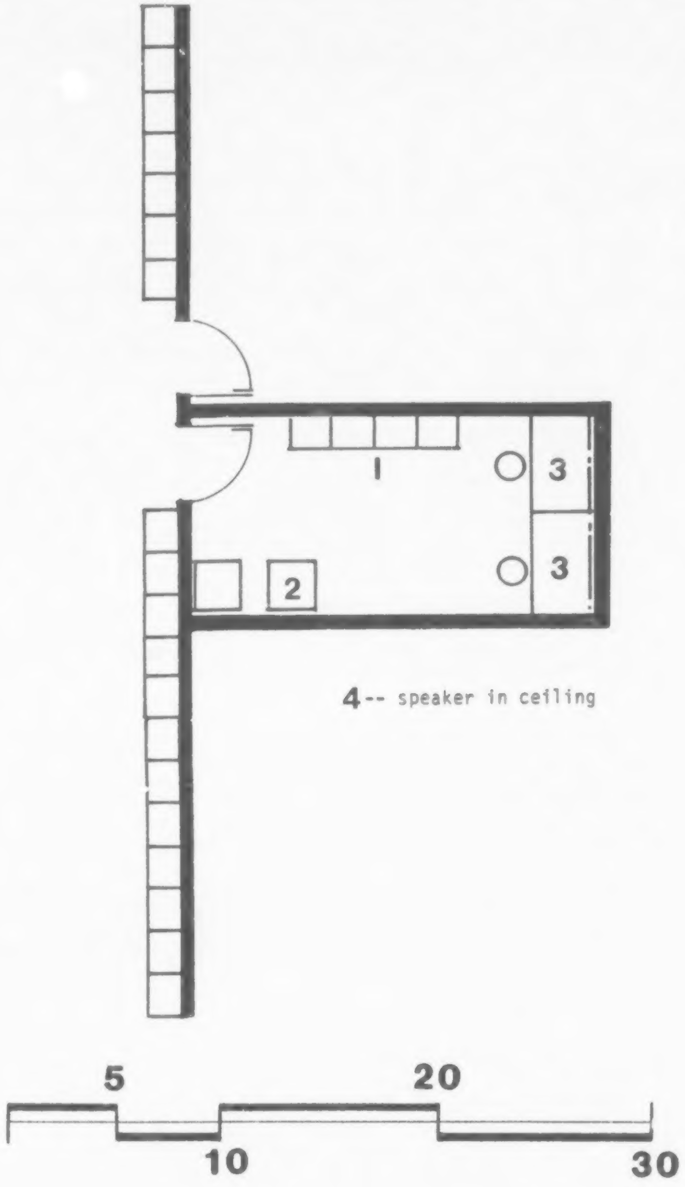
equipment *

1. Cabinets (30 linear feet) with shelves for disks.
2. One file cabinet (five drawers) for records.
3. Two workbenches (30 by 60 inches) with stools for maintenance activities.
4. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

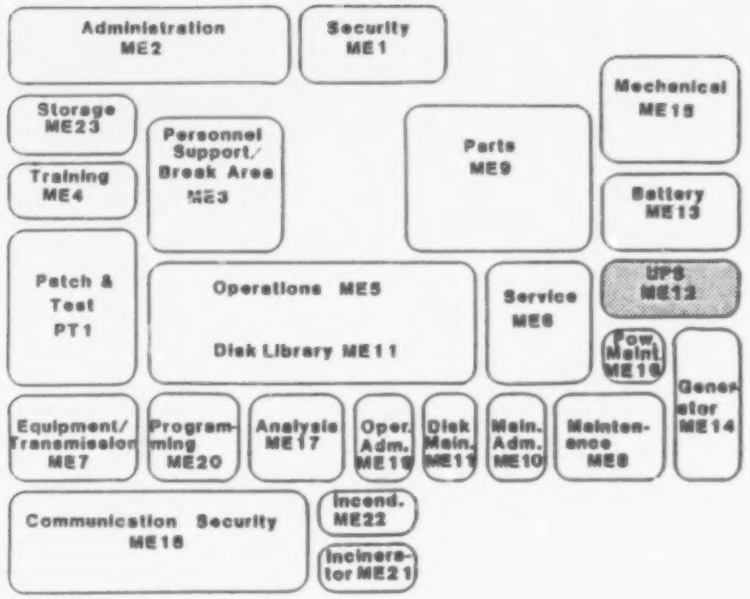
requirements	criteria	commentary
1. Enough space for storing movable head disks and magnetic tapes and to accommodate the maintenance tasks.	**1.** Provide approximately 200 square feet for a maintenance function, with storage along one wall of the operations space. (See ME5 in this volume.)	
2. EMP/HEMP shielding.	**2.** Shielding is necessary for survivability and uninterrupted functioning when the facility is subjected to electromagnetic pulse (EMP) and high altitude electromagnetic pulse (HEMP). Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	**2.** See Vol 2, SB5, EMP/HEMP Protection, for more information.
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation/attenuation for variable noise levels produced by electronic equipment.	**4.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum).	
5. Security for disks and tapes.	**5.** Lockable when unstaffed.	**5.** See Vol 2, SB7, Security (Zone 3), for more information.
6. Adequate lighting.	**6.** Ambient: 40 footcandles. Task: 100 footcandles at file table area.	
7. Controlled temperature and humidity.	**7.** Temperature must be maintained at 70° (±2°), with 50 percent (±5 percent) relative humidity and filtered (dust-free) air ventilation.	**7.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
8. Electrical power.	**8.** Provide 120/208 electrical service. Install 120-volt receptacles at each workstation and workbench for convenience at the appropriate height and/or for every 10 linear feet of wall. Electrical power must fall within the 10,000- to 500,000-watt range, with frequency levels at 50 to 60 hertz ± 5 percent.	**8.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
9. Fire protection/life safety criteria are based on the assumptions that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**9.** Interior finish: Class A or B only. Automatic fire suppression: Water sprinklers Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**9.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance


1
2
3
3
4-- speaker in ceiling
5
20
10
30

guidance

UPS ME12


Administration ME2
Security ME1
Mechanical ME15
Storage ME23
Personnel Support/ Break Area ME3
Parts ME9
Training ME4
Battery ME13
Patch & Test PT1
Operations ME5
Disk Library ME11
Service ME6
UPS ME12
Pow. Maint. ME16
Generator ME14
Equipment/ Transmission ME7
Programming ME20
Analysis ME17
Oper. Adm. ME19
Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

An uninterruptible power supply (UPS) is designed to provide continuous power, without delay or transients, to the critical load.

policy/sop

UPS are characterized by their ability to condition primary or auxiliary power to precise, high-quality power as required by the C-E equipment. UPS maintain continuous power during periods of transfer from one power source to another or for a period long enough to allow for an orderly shutdown. A UPS is required to maintain and provide continuous, conditioned power to the critical C-E equipment and to provide protection from power line transients. The UPS must have the following specific properties.

1. A UPS should serve the critical technical load. It should be solid state with batteries capable of supporting 125 percent of the critical technical load for a minimum of 15 minutes. The UPS is designed to protect equipment from disturbances of voltage and frequency inherent with conventional power distribution systems. The UPS must maintain output voltage and frequency regardless of the nature or severity of the incoming line fluctuations and/or changes in load.

2. The UPS should operate in conjunction with the existing power distribution system to provide quality power for critical technical loads. The system should consist of a solid-state inverter, a battery charger/rectifier, storage batteries, and a static transfer switch with a bypass switch.

3. During normal station operation, the UPS will be supplied with a.c. power by the primary power source; the UPS then changes a.c. power into storable d.c. electrical energy to be used as a short-term, no-break power supply for critical equipment. The UPS uses only a small amount of energy to maintain storage levels. The rest is reconverted into a.c. electrical energy. The UPS' a.c. power input and output are isolated from each other by the energy storage medium. A means should be provided to bypass the UPS completely in the event of failure or maintenance. (1)150 UPS electronic components should be in a room separate from machinery and batteries to prevent their vibration, pollution, overheating, and corrosion. See MIL-HDBK-411A for air-conditioning criteria.

   The four common types of installed UPS are:

   a. Flywheel--motor-generator
   b. Rotary
   c. Electronic
   d. Hybrid

policy / sop

4. The power sources and distribution system should be dependable, free from disturbances, and easily maintained. Efficient operation of the earth complex requires a dependable power system that minimizes the number and length of communication outages. Added to the primary objective of dependability are: (a) cost effectiveness to provide the best possible system for the least amount of money and (b) standardization to aid in cost effectiveness, maintainability, and ease of support. Additional information is available in MIL-HDBK 411A AR 420-43, NAVFAC DM-4, NAVFAC DM12.1, AFM 88-15, and the National Electrical Code. (1) 30

5. A modern solid-state UPS is a reliable source of conditioned power. The UPS usually is provided with an electronically controlled static bypass switch when input and output frequencies are identical. The static switch permits automatic bypass if the UPS fails. Also, a manual bypass switch is often provided to permit maintenance on any part of the UPS system. (1) 153 Solid-state UPS have many advantages over mechanical rotary UPS. Bearing, vibration, and low efficiency problems are avoided, and single-point failures are minimized by selection and proper configuration of solid-state UPS. Reserve battery capacity of 15 minutes is normally enough for bringing the UPS online, at which time the auxiliary power plant should be providing the input power. (19) 17

   See Vol 2, SB2, for detailed information on UPS.

issues and assumptions

1. Selection of UPS

   Single UPS--The single, static UPS has the advantage of simplicity and low cost. The single UPS configuration consists of a rectifier, an inverter, associated controls, protective devices, and an energy storage battery. This system also includes a static bypass circuit that automatically transfers the critical load to the alternate power source without an interruption to the load. When an inverter output failure is sensed, the critical load is transferred to the bypass circuit in less than 5 milliseconds. The synchronous bypass adds about 20 percent to the cost and provides eight to ten times more reliability. UPS failure causes the static switch to transfer the load to the input source, keeping the load online. When selecting this configuration, two conditions must be considered for successful operation: (a) the transfer must be fast enough that the load will not be disconnected and (b) the frequencies and voltages of the primary power and the inverter output must be the same.

   Parallel redundant system--This system consists of at least two UPS operating in a load-sharing mode. The output of each is normally connected to the bus through a static interrupter for protection. If an internal fault occurs within an inverter of either system, the static interrupter isolates that inverter from the bus. In case of a bus fault, the interrupter operates in a current limiting mode until the output circuit breaker trips. Parallel UPS may be configured for various combinations of units operating in parallel, such as three units on-line with any two capable of serving the load. Parallel configuration is recommended when the frequency of the primary electric power supply must be converted to serve the critical load such as 50 to 60 hertz.

   "Cold" standby independent UPS--This configuration consists of two independent UPS with a common battery. One UPS is online and the other is in "cold" standby. Both UPS are equipped with static bypass circuits that, in the event of UPS failure, automatically transfer the critical load to the primary or auxiliary power source without interruption. The second UPS is then energized manually and placed in the bypass mode and the critical load is assumed by the transfer action of the static switch. The two UPS are not intended to operate in parallel and interlock circuits are provided on the UPS output.

issues and assumptions

2. Float battery systems versus solid-state UPS

The float battery system is the most economical and reliable method of providing continuous d.c. power to critical loads. Since this system is inherently very reliable and since future power sources (renewable energy) provide d.c. power, long-range communications plans call for increased use of d.c.-powered electronics. (19) 10

Floating battery power should be designed for optimal reliability and maximal independence of primary power abnormalities. The battery should be sized to furnish full power to the critical technical load for a period consistent with requirements and system design for auxiliary power capabilities. The battery system supporting solid-state UPS should be sized for 15 minutes in most cases. For 48-volt applications, if specific battery operation requirements are not available, the batteries should be sized for 4-hour operation at attended sites and a minimum of 8 hours' operation at unattended sites. A single float battery system should be designed for all float battery requirements in a common facility. A minimum of two rectifier chargers should be provided. The total number of rectifiers required will be determined by the number needed to supply the load and battery charging current, plus one or more for the maintenance space. When operating on commercial power, the rectifiers should be sized to provide a battery recharge-to-discharge time ratio of not more than 30 to 1. When static inverters are used, provisions should be made to transfer the load gradually from the battery to the primary or auxiliary power source. This provision, normally handled by the rectifier, will minimize transient conditions on the primary or auxiliary power source during the transfer period. (19) 22

activities

1. Doing prescribed maintenance and inspection (PMI) work.
2. Conducting operational checks and load tests.

personnel

1. One, though not located in room continuously.

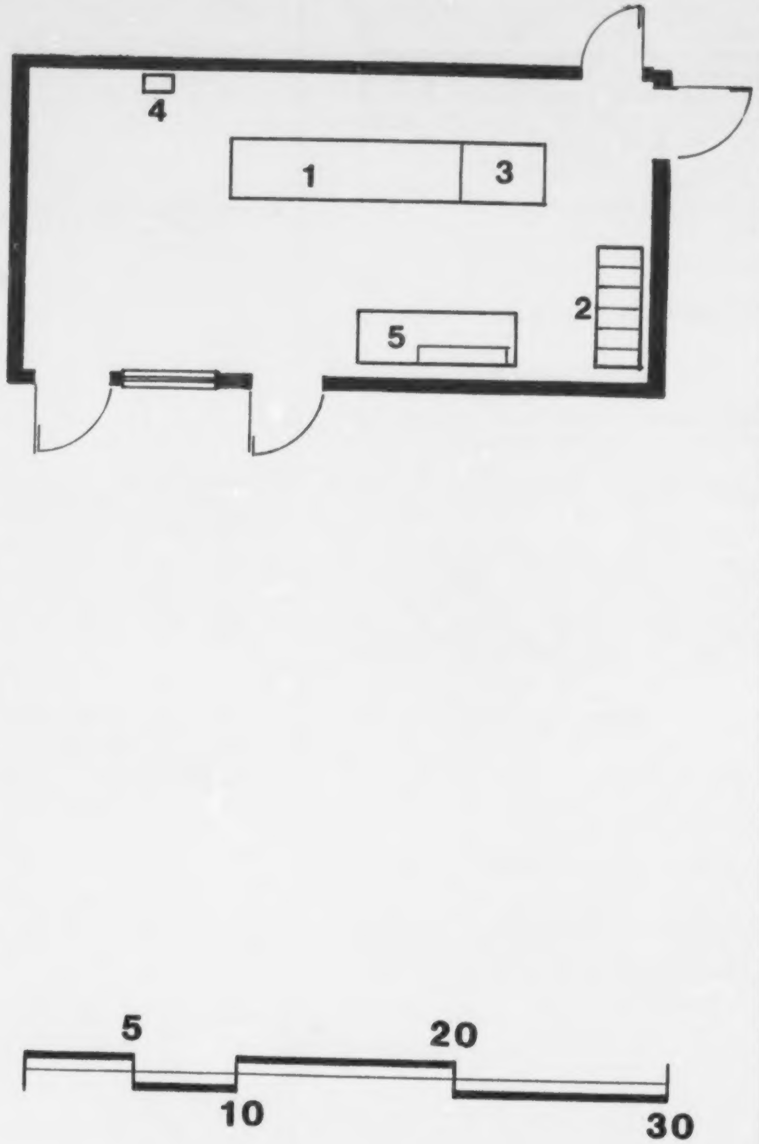
equipment*

1. Solid-state rectifier/charger.
2. Batteries.
3. Inverter, synchronizing equipment.
4. Static switches.
5. Rotary converter (if 60-hertz equipment is used in a 50-hertz host country.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for the operation and monitoring of UPS equipment; proper spacing between equipment for easy maintenance.	**1.** Space needs vary with the communication equipment design (i.e., power requirements), but an average is 400 to 500 square feet. Depending on UPS capacity, certain components are very large and heavy, so consideration must be given to installation and repair or replacement of those items. To accommodate this, knock-out panels may be required. Cable ducts should be located for easy access and drainage.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for variable noise levels produced by electronic equipment.	**3.** Adjacent room walls should limit sound transmission to 40 decibels.	
4. Adequate lighting.	Provide 20-footcandle (ambient) fluorescent fixtures and 70 footcandles (task) for testing and inspection.	
5. Environmental control for proper operation of electronic equipment.	**5.** Regulate temperature at 50°F for heating. Cooling temperature must be less than 90°F for all solid-state UPS equipment.	**5.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
6. Electrical power.	**6.** Commercial electrical service used in the building will be site-specific. Availability depends on the host country if OCONUS. An outdoor transformer can be installed for UPS spaces in terms of the communication equipment and switchgear. Provide 120-volt receptacles as needed.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior enclosure walls--1-hour fire-rated construction. Interior doors--20-minute fire-rated doors. Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location

The UPS and associated battery should be installed in separate rooms. Construction should be permanent type and the wall separating the UPS should be fire-rated (See Vol 2, SB3). Power continuity during emergency periods of power transfer is maintained by an energy storage battery. Reserve battery capacity of 15 minutes normally is enough for bringing the UPS online, during which time the auxiliary power should be providing the input power.

Structural--Minimum floor load is 250 pounds per square foot. A clear ceiling height of 10 feet should be provided.

Doors--All doors to the UPS room should be constructed of steel and should have a minimum dimension of 4.0 by 7.0 feet. Consider installing a louvered bottom door panel on the interior door(s).

5. Environmental control

Consider installing a solid-state UPS in an environmentally controlled room if adverse environmental conditions exist or if recommended by the UPS manufacturer.

best copy available

guidance

Figures ME-1 and ME-2 show the preferred method of heating and ventilating UPS equipment areas, as well as providing the required ventilation system redundancy. The canopy hood, also called a "receiving hood," should be slightly larger than the equipment or exhaust grills in the cabinets and should extend fairly close to them. Direct connections should be avoided unless specifically recommended by the equipment manufacturer. Each exhaust fan should be sized to handle all the air exhausted through the cabinets plus 10 percent (room air) to insure good capture. (5) 3-3-13.

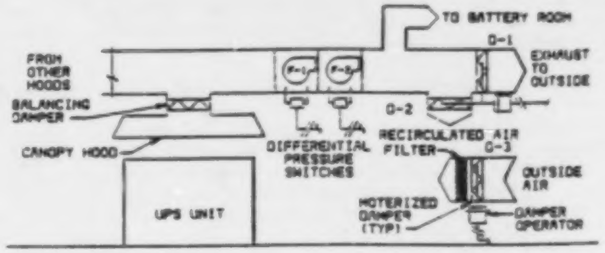

TO BATTERY ROOM
D-1
EXHAUST TO OUTSIDE
FROM OTHER HOODS
F-1
F-2
BALANCING DAMPER
D-2
CANOPY HOOD
DIFFERENTIAL PRESSURE SWITCHES
RECIRCULATED AIR
FILTER
D-3
OUTSIDE AIR
UPS UNIT
MOTERIZED DAMPER (TYP)
DAMPER OPERATOR

FIGURE ME-1. SERIES FAN ARRANGEMENT. (5) 3-3-14

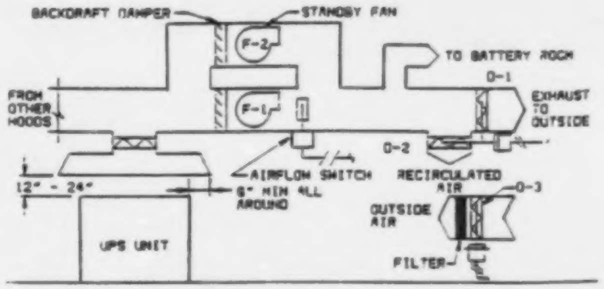
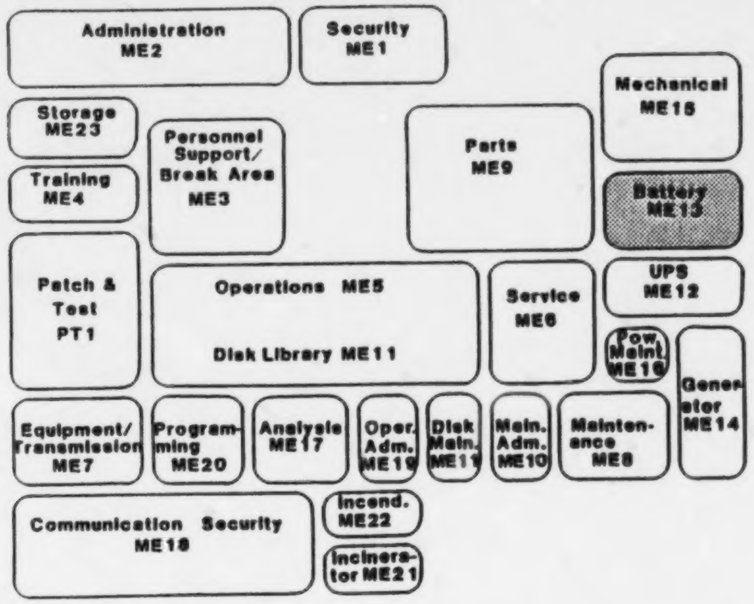

BACKDRAFT DAMPER
STANDBY FAN
F-2
TO BATTERY ROOM
D-1
FROM OTHER HOODS
F-1
EXHAUST TO OUTSIDE
D-2
AIRFLOW SWITCH
RECIRCULATED AIR
12" - 24"
6" MIN ALL AROUND
D-3
OUTSIDE AIR
UPS UNIT
FILTER

FIGURE ME-2. PARALLEL FAN ARRANGEMENT. (5) 3-3-14

guidance

BATTERY ME13


Administration ME2
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Analysis ME17
Oper. Adm. ME19
Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

The battery room houses batteries that help comprise the backup power system (UPS), a system designed to provide continuous power to the critical load without delay.

policy/sop

1. Battery bank. This should be used as a stored energy source for the UPS. The battery's ampere-hour rating should be high enough to support the inverter for the protection time specified with the mover for operating at rated load. The battery should meet input voltage requirements of the inverter section.
2. Construction. Batteries should be the sealed type, assembled in heat-resistant, shock-absorbing, clear plastic containers with covers cemented in place to form a permanent leak-proof seal. Covers should be fitted with explosion-resistant vent caps. Cell post and cover should be sealed by lead-alloy steel nuts. Cell terminal posts should be equipped with connector bolts that have acid-resistant nuts. Enough sediment space should be provided so that the battery will not have to be cleaned during its normal life. Electrolyte level lines shall be marked on all four sides of the container.
3. Ground protection. The battery should have a high-resistance ground and a ground detection alarm for maximum safety; this will be an integral part of the UPS.
4. UPS batteries should be isolated from machinery in a properly designed battery room to prevent their damage from vibration, pollution, overheating, or explosion.

issues and assumptions

1. Batteries versus generators for "backup" power

The use of batteries as the only backup power is impractical at high-power communications facilities. Some use can be made of batteries for backup at receiving facilities and possibly for low-power (up to 1 kilowatt) transmitter radio facilities, but even this is questionable. Normally, there will be engine-driven generators at the facility to pick up the load within approximately 1 minute of the power failure. Maintaining large banks of batteries for use during an occasional power outage may not be cost-effective. (87) Vol 2, 86

activities

1. Inspecting battery system quarterly.

personnel

1. None assigned fulltime.

equipment *

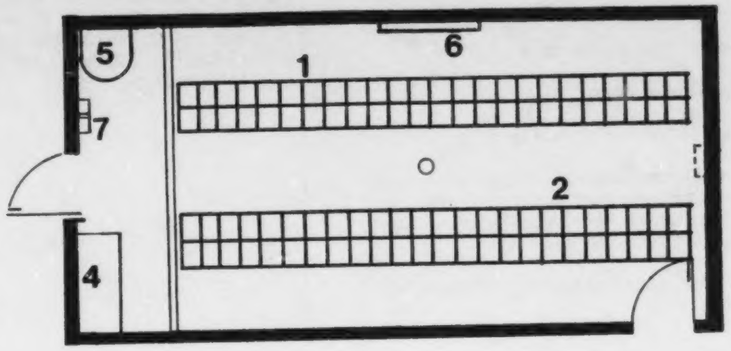
1. Lead acid batteries.
2. Battery racks.
3. Rectifier chargers.
4. Counter workbench for battery maintenance.
5. Emergency eyewash fountain and shower.
6. Safety board, 96 by 48 inches, wall-mounted.
7. Four cans of soda and four jars of distilled water.

* see "guidance" box for example layout of all equipment listed.

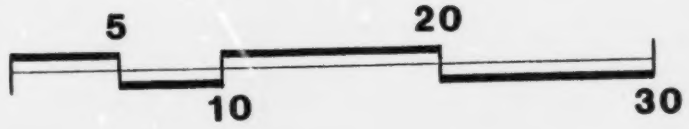
requirements	criteria	commentary
1. Enough space for batteries and rectifier chargers to contain the proper safety equipment associated with the battery function.	**1.** Approximately 900 square feet are needed to provide space for battery racks, emergency eyewash, and shower equipment.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Concrete, hardened and sealed. The battery room requires treatment with an acid-resistant floor hardener. Base--Not applicable. Walls--Paint with tile wainscot of 48 inches. Ceiling--Exposed and painted.	**2.** See also Vol 2--"Site and Building Information," SB2, Interior Construction and Finishes.
3. Acoustical isolation for adjacent mechanical equipment rooms that produce variable noise levels.	**3.** Adjacent room walls should limit sound transmission to 40 decibels.	
4. Acid removal.	**4.** A special drain system is needed to accommodate acid spills. Provide a curb to contain acid and keep it from entering the shower drainage area.	**4.** The battery room contains highly explosive fluids and fumes. It is important that item specifications be explosion-proof and meet Occupational Safety and Health Administration (OSHA) regulations. Recommend a pumpable acid holding tank that will hold up to 50% of acid volume.
Safety board.	**5.** Use 96- by 48-inch mounted board for assigned safety gear and a large enough floor area to store four cans of soda and four jars of distilled water.	
6. Separate exhaust ventilation system to outside.	**6.** An interlock must be provided to deenergize charging circuits if ventilation fails or shuts down. See SB2, Special Mechanical Systems, for ventilation rates.	
7. Adequate lighting.	**7.** Use 60-footcandle fluorescent lighting in corrosion-proof and explosion proof fixtures.	
8. Thermal comfort.	**8.** Maintain temperature at 60°F for heating. 104°F is the maximum allowable temperature.	**8.** See also Vol 2, SB2, Communication Station Buildings, Mechanical.
9. Electrical power.	**9.** Provide 120/208 electrical service. All 120-volt fixtures and switches are to be Class II. Locate one receptacle for every 10 linear feet of wall. Metal battery racks will be grounded to the earth ground system. (Explosion-proof electrical receptacles and fixture explosion venting are not required, but are recommended.)	**9.** See also Vol 2, SB2, Communication Station Buildings, Electrical. Air Force recommends no receptacles in Battery and will not usually use electrical equipment in room.

requirements	criteria	commentary
10. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**10.** Interior enclosure walls--1-hour fire-rated construction Interior doors--20-minute fire-rated doors Interior finish--Class A or B only Automatic fire suppression--Water sprinklers Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility Explosion-proof electrical receptacles and fixture explosion venting.	**10.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



Rectifier chargers may not be physically co-located with the batteries.



guidance

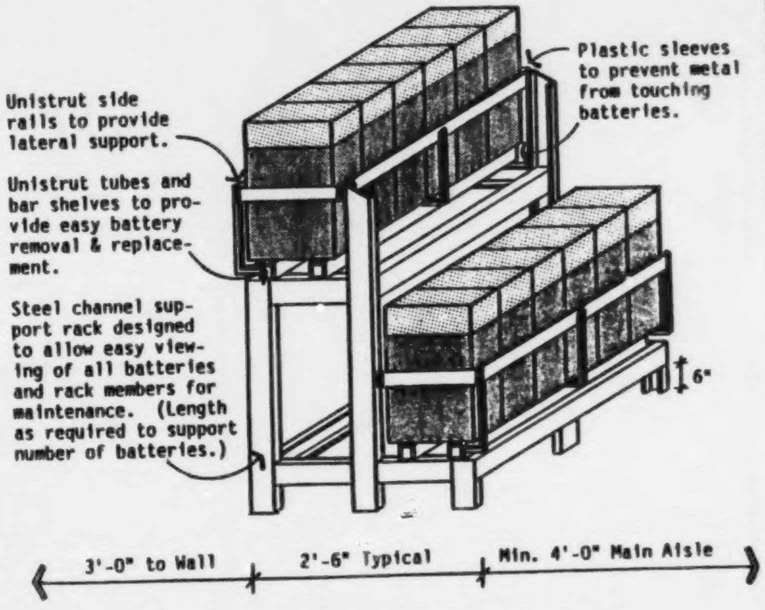
1. Location

Battery rooms, consisting of cells mounted on manufacturer-supplied battery racks, are normally adjacent to the UPS equipment room. The battery room should be windowless, reasonably well insulated against heat loss and gain, and located to minimize solar gain. Frequency conversion equipment should be as close as possible to the equipment it serves. Motor generators should be located in a separate room to reduce noise levels and heat gains in operating spaces. Static converters can be located in the equipment space or operating space because they produce minimal heat and noise. (92) 12.1-12

Spatial needs

The 48-volt d.c. battery set consists of 24 cells with interconnections, mounted in a two-tier seismic-resistant rack.

A suitable galvanized steel rack should be furnished. Lead-plated copper interrack connectors and cell numbers should be provided. Plastic covers should be provided to insulate rails and cells. Racks should be painted with two coats of acid-resistant paint.


Plastic sleeves to prevent metal from touching batteries.
Unistrut side rails to provide lateral support.
Unistrut tubes and bar shelves to provide easy battery removal & replacement.
Steel channel support rack designed to allow easy viewing of all batteries and rack members for maintenance. (Length as required to support number of batteries.)
6"
3'-0" to Wall
2'-6" Typical
Min. 4'-0" Main Aisle

TYPICAL BATTERY STORAGE RACK

guidance

The 48-volt d.c. power can consist of two, three, or four rectifiers with storage batteries sized properly to meet each site's power requirements. The rectifiers can be operated in a parallel/redundant mode, which extends the equipment life and provides uninterrupted service should one cell fail. Rectifiers should have a "current walk-in" feature for a smooth increase in current with initial power-up to protect the load and prevent accidental circuit breaker tripping. Rectifiers also should have a current limit control that can be adjusted from 90 to 125 percent to limit the output current. A voltmeter and an ammeter can indicate rectifier operation and front panel alarm lights are available for external monitoring. Battery plant capacity should be sized to support the total load. (88)G-1

2. Durable surfaces

All floors, walls, and ceilings should be made of acid-resistant materials. Exposed concrete is recommended for the floor.

All doors to the battery room should be constructed of steel and should have a minimum dimension of 4.0 by 7.0 feet (1.22 by 2.14 meters). Consider installing a louvered bottom panel on the interior door(s).

Exhaust fans in the battery room should be covered with security bars and be explosion-proof. See SB7 in Vol. 2.

The battery room floor design load should be 250 pounds per square foot (1220 kilograms per square meter).

4. Acid Removal

All required actions must be taken to meet host country laws and regulations against the water and air pollution. An acid-resistant drain line should be installed between the battery room floor drain and the "pumpable" holding tank for chemical waste. Connections to sewage lines is unacceptable. Vent lines also should be acid-resistant.

6. Exhaust ventilation

The battery room is to be supplied with its own ventilation intake and exhaust ports to outside air. (40) 6-8

The central ventilation system supporting air to and exhausting air from the building can be used to supply air to the battery room for exhausting to the outside. (40) 6-8

Battery rooms shall be ventilated with nonsparking, explosion-proof, continuously operating exhaust fans to maintain a stable room pressure that is lower than that in adjoining rooms to prevent the outflow of contaminated air to other rooms. Required outdoor air ventilation rates for batteries and equipment shall be obtained from the manufacturer and shall be used in designing the environmental control system.

guidance

The battery room is normally ventilated by wall fans or power roof ventilators. Fans are sized so that either is adequate to limit hydrogen gas buildup to 2 percent. Both fans should have manual starters. If wall-mounted, they should be high enough to avoid hydrogen buildup near the ceiling. Backup electrical unit heaters sized to maintain a minimum temperature of 60°F (15°C) should be provided for times when waste heat is not enough to maintain the battery room temperature at its winter design level. Heaters should be on the utility or normal power circuit.

7. Lighting design

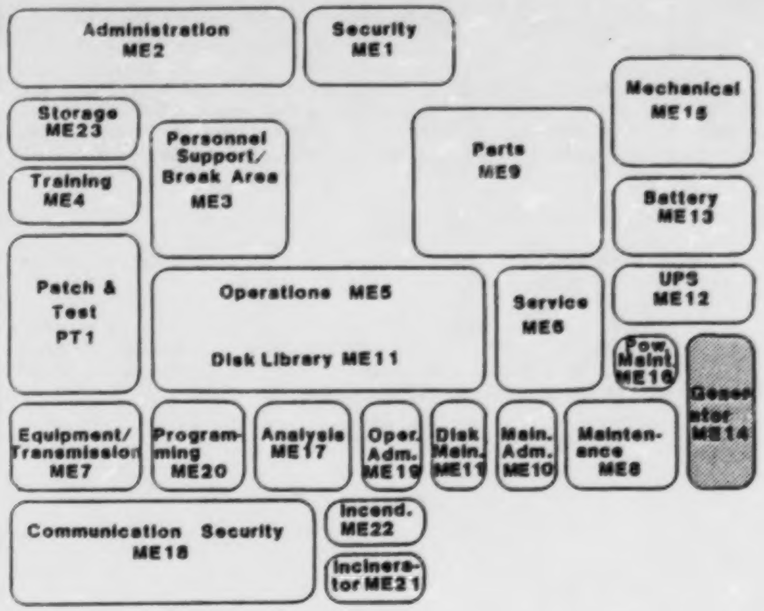
Explosion-proof fluorescent lighting fixtures should be installed in the battery room. Lighting levels in the battery room should be no less than 30 footcandles, 25 measured 30 inches from the floor. The light switch should be located outside of the battery room on the wall next to the door.

10. Life safety

A combination emergency deluge shower and eyewash fountain should be installed in the battery room.

Battery Rack: At all sites, the seismic category should be considered. For example, safety restraint rails are recommended to hold batteries securely in place. A minimum of category I earthquake proof racks are recommended for use at all locations.

GENERATOR ME14


Administration ME2
Security ME1
Mechanical ME15
Storage ME23
Personnel Support/ Break Area ME3
Parts ME9
Training ME4
Battery ME13
Patch & Test PT1
Operations ME5
Disk Library ME11
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Programming ME20
Analysis ME17
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Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

Facility generators maintain power to all communication systems when the commercial power fails.

policy/sop

1. Facilities usually will have three generators as a backup power source in the event of commercial power failure:

   - One generator will be online, set for automatic startup
   - Another will be backup to the first, in case of failure
   - A third generator will be considered "in maintenance" condition to be available if the backup generator fails.

   (See MIL-HDBK 411A for specific policies on the various generator classes.)

2. Primary power requirements for a communications facility are determined by the system configuration and include equipment loads (technical power), utility and domestic loads, and provisions for future expansion. The architectural engineering agency is responsible for designing the site primary power system and its distribution. One of the most economical, convenient sources of auxiliary power is the diesel-engine generator. However, an engine-driven generator requires time to start and warm up, causing a delay before taking the load after a power failure. The recommended practice is to use storage batteries to provide power instantly and economically. They are kept fully charged by the primary power source during normal operation and, when failure occurs, they assume the load instantly without interruption to service. Batteries lack the capacity to supply power for a long period of time, so it is necessary to have an auxiliary generator available. (70) 15-11

3. On-station prime power plants are considered only when the local power is either extremely unreliable or prohibitively expensive, when no power is available, or when self-sufficiency is required for survival and reliability in a wartime environment. On-station prime power plants normally use multiple sets of DOD standard family, diesel-engine generator sets for the power source. Other sources (such as wind turbines, thermoelectric generators, fuel cells, gas-turbine generators, steam-turbine generators, and nonstandard diesel-engide generators) can also be used and should be considered when requirements for a wartime DCS dictate. An onstation prime power plant will use a minimum of three engine generator sets with one set online to carry the station load, one set as a standby, and one set as a maintenance spare. A more reliable configuration is to use four or five generator sets with two online in a load-sharing mode, one as a cold standby unit and one or two as maintenance spares. When the station's standby power requirements exceed 70

policy / sop

percent of the total power requirements and the standby power is redundant, a study should be done in accordance with DOD 4270.1-M to determine if it would be more economical to provide a total energy system that produces both electrical and steam power to be used as needed. (1) 31

4. Site personnel efficiency will be improved if it is possible to locate noisy mechanical equipment, like some diesel generators, away in housing separate from working and living areas or if some other type of noise control is provided. Also, care must be taken to insure that fresh air intakes do not catch fumes or odors from sources such as diesel generators. (2) 5-25

5. All onsite power sources (generators) and substations should be located at a point in the station boundary for which security is adequate. Additional guidelines for locating power sources and substations are: (1) 32

   a. The primary onsite power source should be located far enough from the station work areas to insure acceptable noise levels as outlined by the acoustical noise requirements of MIL-STD-1472.

   b. The primary substation should be located for convenient delivery of power from an off-station source and for easy distribution of the power to onsite facilities as required.

   c. Distribution substations should be located as close as possible to the parts of the operating building they serve.

6. Total fuel storage tank capacity should be determined by local replenishment opportunities, but should hold at least a 30-day supply for primary Class A on-station generators per MIL HDBK 411A. Class C generators require a 7-day minimum supply and Class B generators require a 15-day minimum stored fuel supply. The storage tank(s) should be constructed of fiberglass and when practical, installed underground on an incline to prevent sediment accumulation. Provisions should be made for easy filling and removal of water and other sediment. (19) 13.

issues and assumptions

1. Commercial power versus generators

The mission of DCS communication facilities is to provide reliable communications 24 hours per day. Ideally, the power source for the mission equipment should be reliable, well regulated, easily maintained, and free of transients and disturbances. In actual practice, these desirable characteristics are seldom achieved on a long-term basis. Other factors to be considered in the choice of a facility power supply are:

   a. Providing the best possible system for the least amount of money (cost effectiveness).

   b. Standardizing for better cost effectiveness.

   c. Providing easy support (maintainability). (87) Vol 2, 62

Normally, a DCS communications facility will operate from commercial power using local generators for backup. In some areas of the world, however, commercial power may not be available or if it is, it may be so unreliable as to be unusable for the technical load. Such supplies may be satisfactory for the nontechnical load (area lighting, housing, etc.). In such cases, the primary power source should consist of generators located on the facility site. (87) Vol 2, 83

2. Comparison of engine generators

The selection of an engine generator to supply an independent power source (primary and/or standby) depends on several factors. The choice is usually between a diesel and a gasoline engine. Each has properties that determine its suitability for a particular application.

The diesel engine is suitable for either continuous or part-time service. Initial cost is slightly higher than that of a comparable gasoline engine; for certain applications, however, this disadvantage is more than offset by advantages. The diesel engine is extremely rugged, uses less and lower cost fuel, has a long life expectancy, and offers maximal reliability. Reasons for these advantages include (a) diesel fuel has a higher energy content than gasoline or liquid petroleum, (b) diesel engine operating speed is approximately half that of the gasoline engine, and (c) the diesel engine does not require an electrical ignition system. The last two factors account for lower maintenance and overhaul costs for the diesel engine. Engine starting time is comparable for diesel and gasoline engines.

Gasoline engines can be used for continuous power, but are better suited for standby use. As mentioned previously, the gasoline engine has a lower initial cost, but also a shorter life expectancy. It has a higher operating speed, which wears out the engine more rapidly. It uses more and higher operating speeds, which also wear the engine out more rapidly. It uses more and higher cost fuel and is not as reliable as a diesel engine. One reason for poor reliability is that a gasoline engine uses an electrical ignition system which is subject to failure due to dampness, age, and carbon buildup. (70) 14-3

issues and assumptions

3. Level of maintenance performed

If depot level maintenance is required and authorized, an open area, benches, and special tools (torque wrenches) also are required in the generator room. This is especially true at Navy installations, which require more extensive repair onsite.

4. Above-ground versus below-ground oil storage tank

To insure protection from hostile attack, below-ground tanks provide better security for the standby power system; however, above-ground tanks are cleaned, repaired, and maintained more efficiently, effectively, and economically.

5. Sizing generator fuel tanks

Engine generator size depends on the station's power requirements. The fuel tank capacity for these units depends on the site's accessibility and the size of the engine generators. It should not be necessary to refill fuel tanks more than once a month. If inclement weather or undue hardship dictates a longer period of time between refuelings, a larger tank is recommended. The approximate rate of fuel consumption of a diesel-driven generator, in gallons per hour, can be calculated by multiplying the output in kilowatts by 0.136; this calculation will be helpful in determining the size of tank needed. (70) 14-2

activities

1. Starting the on-line generators after commercial power failure.
2. Repairing and maintaining generators.

personnel

1. Two personnel, though not in room continuously.

equipment**

1. One "set" of generators.* (Usually Class C.)
2. Batteries for start-up.
3. Fuel tank with dispensing pump. (Tank capacity varies with size of generators and reliability level of primary commercial power.)

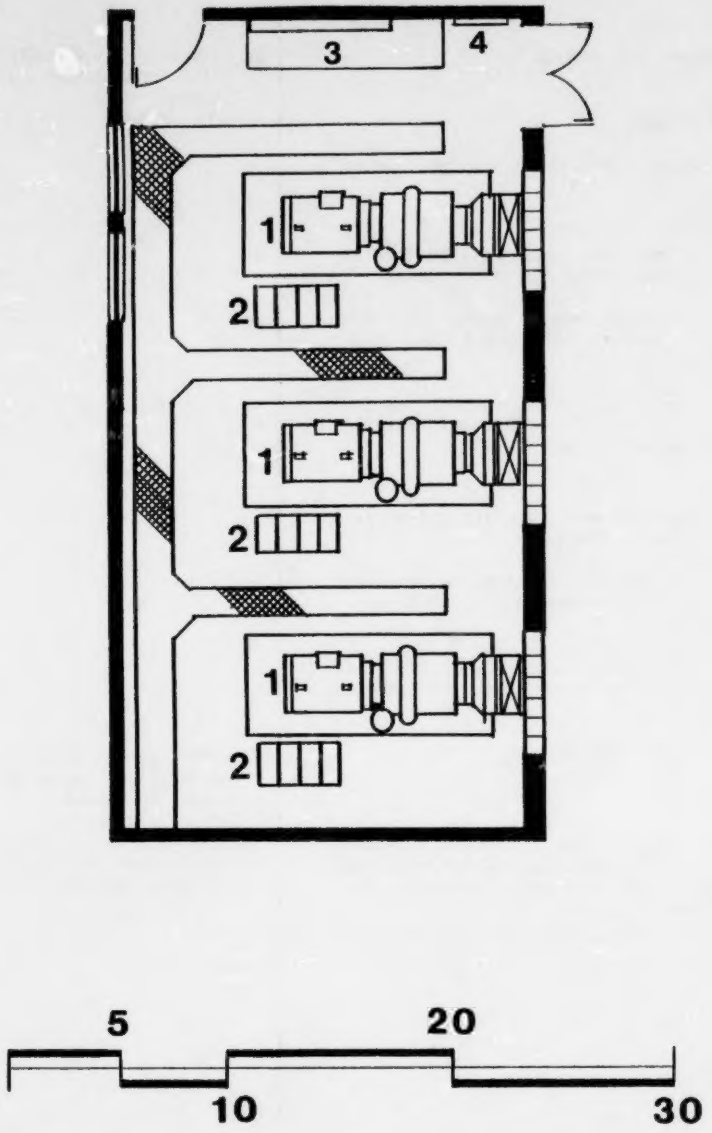
   See MIL-HDBK 411 for the specific capacity in relationship to a class of generators.
4. Alarm panel.
5. Automatic transfer switches.

*The number and size of generators will vary among facilities depending on the voltage required to maintain the mission.

** see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for the installation, removal, and repair of standby generators.	**1.** Space needs vary with power requirements (see guidance drawing). Allow approximately 800 square feet for three generators.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustic isolation for variable noise levels produced by mechanical equipment.	**3.** Adjacent room walls should limit sound transmission to 40 decibels.	
4. Generator operation indicator and alarms.	**4.** An alarm and operation indicator panel will be located at the control console area of the operations space.	
5. Emergency lighting.	**5.** Emergency lighting should be bright enough to allow switch gear operation, instruction reading, and other mission-essential activities.	
6. Environmental control to provide generators' constant supply of make-up air for combustion and cooling.	**6.** Provide automatically adjusted louver units sized for capacity of generator selected. Exhaust stacks must be caged to prevent bird/animal entry.	
7. Vibration control.	**7.** The generators must be placed on a concrete pad physically isolated from the main floor.	
8. Design that allows complete removal and exchange of generator units.	**8.** Air intake/exhaust units should be located and sized to become a "knock-out" panel for removing a complete generator.	
9. Adequate lighting.	**9.** Use 40 footcandles (ambient). "Slow start" fixtures such as mercury vapor should not be used, nor should fluorescent fixtures.	
10. Thermal comfort.	**10.** Regulate temperature at 50°F for heating.	**10.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
11. Electrical power.	**11.** Provide 120/208 electrical service. Install 120-volt outlets; at least two duplex receptacles are required at workbench areas and at the appropriate height. Use 240-volt receptacles when required. Provide host nation standard outlets if applicable.	**11.** See also Vol 2, SB2, Communication Station Buildings--Electrical.

guidance



guidance

1. Location

If a standby generator is to operate continuously for instantaneous commercial power backup, the generator room should be located away from all normal operational spaces to isolate the noise.

Clearances--All ducts and other systems installed in the facility as part of the finished structure should be arranged to maintain a 10-foot unobstructed clearance from the floor to the ceiling.

Structural--Isolate the foundations of each generator to prevent transfer of engine vibrations to the building. Floor loading should be designed to accommodate a steady load of the heaviest auxiliary diesel engine generator designed/selected by the contractor. Pad dimensions may exceed the engine dimensions by 25 to 30 percent.

Doors--All single doors should be constructed of steel and should have a minimum dimension of 4.0 by 7.0 feet. The exterior equipment door for the generator room should be double-wing type with minimum dimensions of 6.0 by 7.0 feet. This door should be equipped with a drop-in horizontal bar to secure it from the inside.

Storage tank--When required, provide an underground fuel oil storage tank adjacent to the power/mechanical room. Also provide fuel oil supply and return lines, fill pipe, oil level gage, and alarm conduits. This tank must be equipped with a float switch to activate an alarm indicating a low fuel oil condition.

A single storage tank should be provided for a minimum fuel supply for both the heating boiler and diesel engine generators. MIL HDMB 411A requires Class C generators to reserve a 7-day supply, Class B generators should reserve a 15-day supply, and Class A generators should reserve a 30-day supply. A fiberglass underground tank should be used. A day tank should be provided in the building to supply fuel to both the heating boiler and diesel engine generators. (See also Vol. 2, SB1, Site Planning and Development).

Provide floor trenches in the power/mechanical room for supply and return fuel lines from the exterior fuel oil storage tank and for cable runs from the generator to the transfer switch and main distribution panel. Floor trenches should have 0.25-inch-thick steel plate covers.

guidance

4. Alarm system

Provide a wall-mounted alarm terminal panel in the generator room. The following alarms will be terminated there:

- Generator status
- Commercial power status
- Low fuel oil level (48-hour supply)
- High (80°F) or low (55°F) temperature status in communication equipment and power mechanical room
- Generator start failure.

The termination board or its associated housing should have all alarm terminations identified clearly with permanent marking or labels for future extensions of these connections to a control and fault alarm system. The alarm sensors should incorporate only dry contacts (no voltages) and should use two conductor shielded cables in the circuit runs or in conduit to the consolidated terminal panel noted above.

Provide adequate grounding cable from the building ring ground system, when applicable, to the diesel generator set metal frame and to the underground fuel oil storage tank. See Vol 2, SB4.

6. Environmental control

Generator exhausts should be located such that fumes will not be sucked into other HVAC air intakes. Emergency generators can be located inside the operations building if they are isolated properly from the rest of the structure in terms of fire protection, sound attenuation, and vibration control. (92) 12.1-12

Louvers and Openings

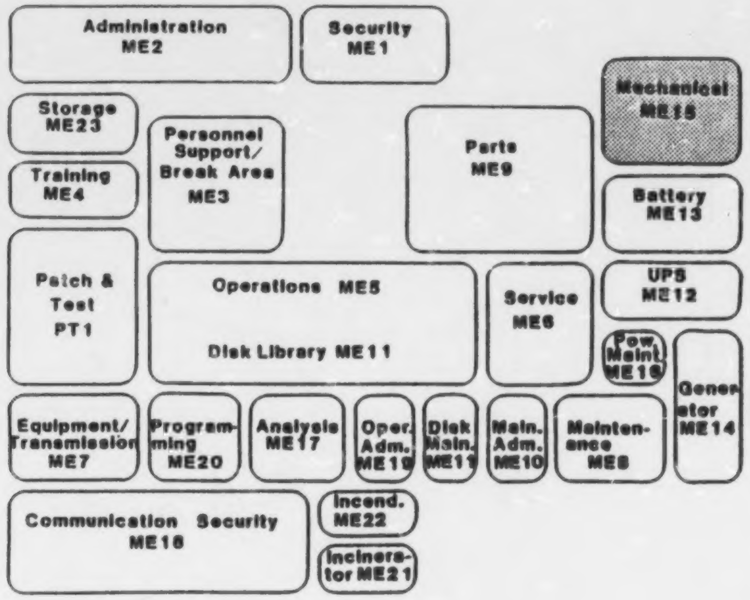
Provide motorized air damper openings in the generator room walls to accommodate diesel engine combustion air requirements. Dampers should automatically activate when generator starts.

Provide security bars on all openings subject to physical intrusion (greater than 7.6 feet in perimeter) such as air intake and exhaust louvers. Their attachment to the structure must be nonremovable from the exterior.

See Vol 2, SB7, for security guidance.

guidance

MECHANICAL ME15


Administration ME2
Security ME1
Storage ME23
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Battery ME13
Patch & Test PT1
Operations ME5
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Generator ME14
Equipment/ Transmission ME7
Programming ME20
Analysis ME17
Oper. Adm. ME19
Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

This module provides space for equipment to supply all the heating, ventilating, and air-conditioning (HVAC) and water requirements for the entire facility. It must also be flexible and spacious enough to accommodate alternative energy sources.

policy/sop

1. It is desirable to provide a separate room for mechanical equipment such as heat exchangers, air-conditioners, and waveguide dehydrators-pressurizers. Heat exchangers must have air intake and exhaust ducts to the outside of the building. The size of these ducts dictates that heat exchangers must be located close to the wall. It must not be overlooked that some types of heat exchangers may require rear access for maintenance. Location of the dehydrating-pressurizing equipment is not critical. However, ease of access for maintenance is desirable and the pressure gages should be readily visible to the maintenance personnel. The air-conditioning equipment location will depend on the specific type provided and whether or not intake and outside exhaust are required. (2) 5-24

issues and assumptions

1. Calculation of space requirements

   a. Heating for each area of the facility is commonly provided by an oil-fired hot-water boiler located in the mechanical equipment room. During the heating season, hot water is supplied from the boiler to the various heating, air-conditioning, and domestic hot-water systems. In the summer, domestic hot water is provided by a small oil-fired hot-water heater and the boiler is turned off. This arrangement will add to boiler efficiency and energy conservation.

   b. Provisions will be made in the mechanical equipment rooms to allow for removal of tubes from boilers and chillers as well as the removal of coils and filters from air handling units for maintenance and replacement. All equipment will be located to allow easy access for maintenance and servicing.

   c. Usage will be 24 hours per day, 7 days per week. No special provisions for peak usage are required.

activities

1. Maintaining, controlling, and inspecting mechanical equipment.

personnel

equipment *

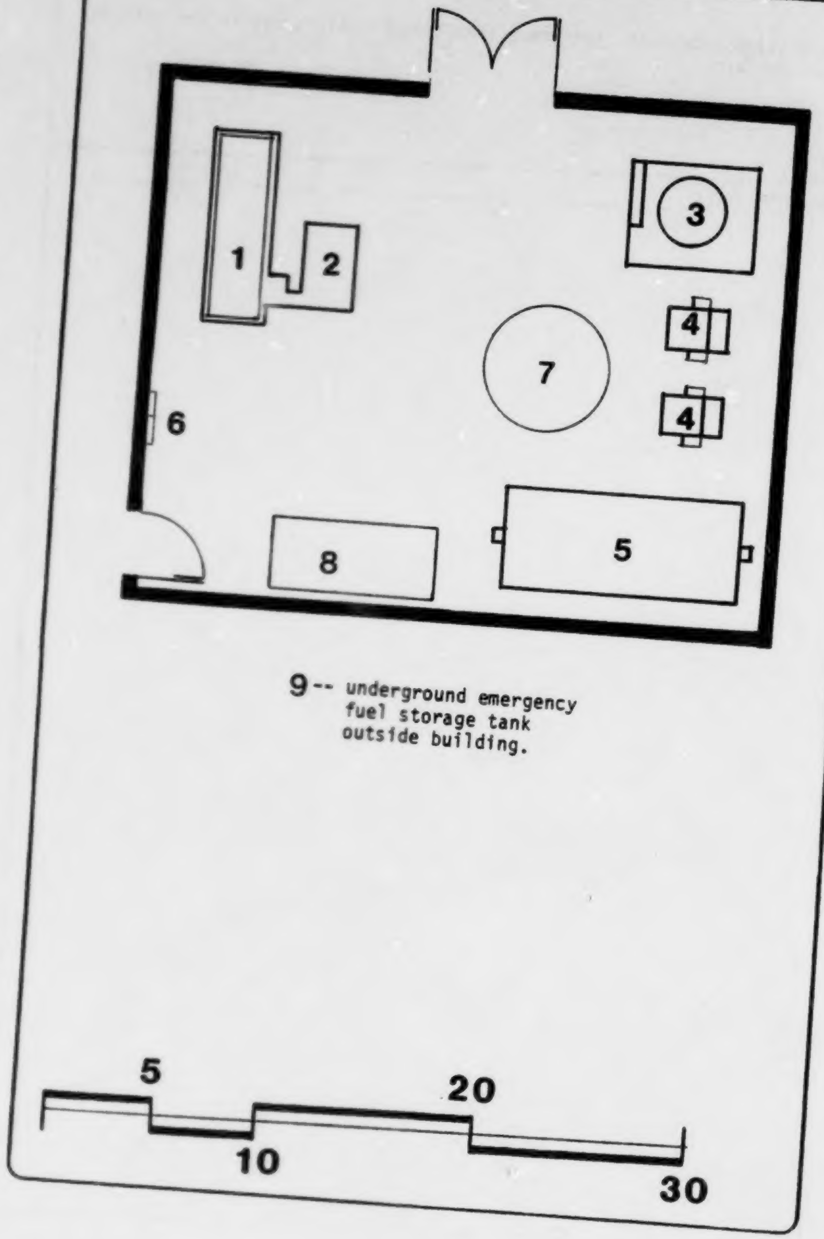
1. Chiller.
2. Condenser.
3. Compressor.
4. Water pumps.
5. Boiler.
6. Electrical switchboard.
7. Emergency water supply tank.
8. Day fuel tank.
9. Emergency fuel storage tank. (Underground--see Vol 2, SB8.)

Note: Alternative energy sources may vary and alter equipment needs. See Vol 2, SB6--AES, for information.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate the mechanical equipment requirements associated with the facility's environmental maintenance.	1. The ratio of mechanical equipment space to the total facility interior floor space varies from 7 percent for small facilities to about 4 percent for large facilities. (See "Issues" box.)	
2. Interior finishes suitable for durability, maintenance, and room function.	2. Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	2. See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation for variable noise levels produced by mechanical equipment.	3. Adjacent room walls should limit sound transmission to 40 decibels.	
4. Information display.	4. The operating instructions, preventive maintenance schedule, wiring and control diagrams, and detailed control sequence should be framed under glass or plastic and posted for easy reference.	
5. Water supply and sanitary sewer.	5. The water supply and sanitary sewer for this facility will be connected to the existing post systems or as prescribed for foreign locations. Provide an emergency water supply tank of 20-gallon per capita capacity for 7 days. Water must be refreshed periodically. See Vol 2, SB8, Survivability Protection.	
6. Adequate lighting.	6. Provide 40-footcandle fluorescent fixtures (ambient).	
7. Thermal comfort.	7. 50 to 68°F range (winter heating), except for batteries, which must be kept at 60 to 68°F.	7. See also Vol 2, SB2--Communication Station Buildings--Mechanical.
8. Electrical power.	8. Commercial electrical service used in the building will be site-specific. Availability depends on the host country if OCONUS. An outdoor transformer can be installed for the mechanical space in terms of general building power. Install 120-volt receptacles as needed. Electrical power must fall within the 10,000- to 500,000-watt range. Frequency levels should be at 50 to 60 hertz ± 5 percent.	8. See also Vol 2, SB2, Communication Station Buildings--Electrical.
9. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	9. Interior enclosure walls--1-hour fire-rated construction. Interior doors--20-minute fire-rated. Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	9. See Standardized Modules--Building Design Principles, Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance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9-- underground emergency fuel storage tank outside building.
5
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20
30

guidance

1. Storage tank

A single storage tank should be provided for a minimum 15-day supply for both the heating boiler and diesel engine generators. A fiberglass underground tank should be used. A day tank should be provided in the building to supply fuel to both the heating boiler and diesel engine generators. This tank must be equipped with a float switch to activate an alarm indicating a low fuel oil condition.

Doors--The exterior equipment doors should be steel, double swing type with steel frame. The inner opening should be at minimum 6 feet wide by 7 feet high. The equipment door should be equipped with interior locking panic hardware.

Both the exterior personnel and equipment door hinges must be welded to prevent removal of hinge pins if pivots and pins are on the outside.

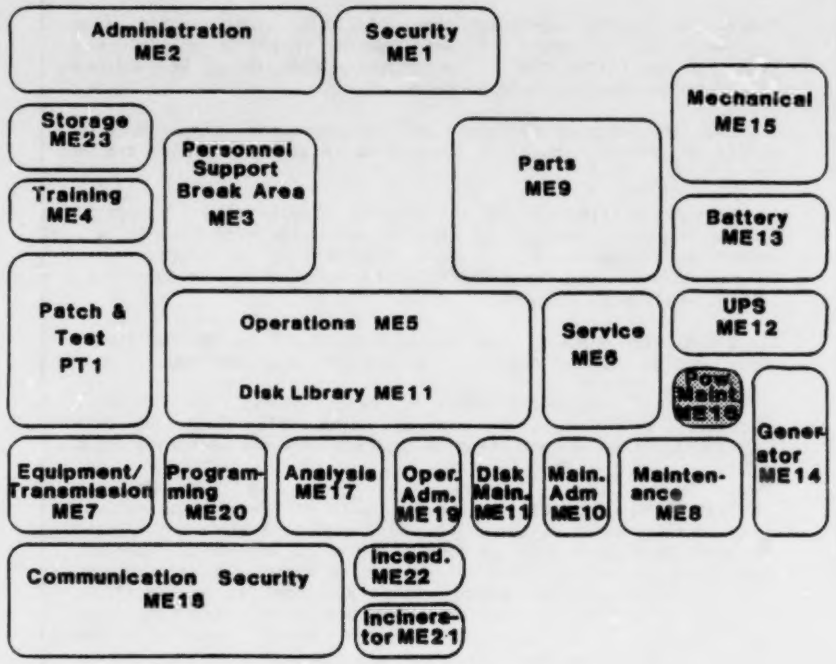
Provide security bars on all openings greater than 7.6 feet at the perimeter and subject to physical intrusion (for example, air intake and exhaust louvers). Their attachment to the structure must be nonremovable from the exterior. See Vol 2, SB7, for additional security guidance.

Structural--The minimum floor design load is 150 pounds per square foot. A clear ceiling height of 10 feet should be provided.

Mechanical equipment should be isolated to minimize vibrations. This can be done by mechanically isolating each individual system on concrete pads separate from the mechanical room floor.

Heat exchangers must be provided with air intake and exhaust ducts to the outside of the building. The size of these ducts means the heat exchangers must be located close to the wall. However, some types of heat exchangers require rear access for maintenance. Location of dehydration pressurization equipment is not critical, but ease of access for maintenance is desirable. Pressure gages should be readily visible to maintenance personnel. Location of the air-conditioning equipment depends on the specific type provided and whether intake and exhaust to the building's outside are required. (2) 5-25

POWER MAINTENANCE ME16


Administration ME2
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Disk Main. ME11
Main. Adm ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

To provide administration space that specifically supports the maintenance activity.

policy/sop

issues and assumptions

1. Enclosed office versus open area workstation

Noncommissioned officers in charge (NCOIC) and their assistants usually occupy an office workstation in the maintenance room itself. This makes their work difficult due to high noise and activity levels. If an enclosed office is provided, however, a view window to the console area must be installed.

activities

1. Distributing directives, orders, and policy statements, both written and verbal, to shift supervisors.
2. Planning exercises and contingencies.
3. Managing the maintenance function.
4. Conferring with personnel (one-on-one).
5. Writing/typing reports.
6. Communicating maintenance and service functions.

personnel

1. Maintenance NCOIC.
2. Maintenance supervisor.

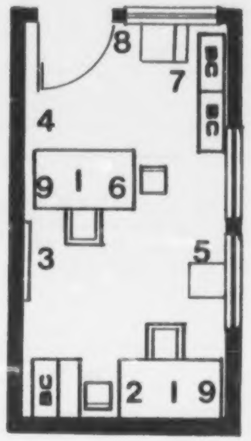
equipment*

1. Two desks with chairs.
2. Typewriter/word processor with stand.
3. Tackboard.
4. Scheduling board (4 by 8 feet) and multiboard (4 by 8 feet).
5. File cabinet (five drawers).
6. CRT terminal.
7. Filesafe (five drawers).
8. Station log.
9. Telephone.
10. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate the equipment and furniture associated with the maintenance function.	**1.** Provide administrative space for two supervisors with the required desks and chairs, bookcases, and file cabinets--approximately 200 square feet for two persons.	
2. Communication lines (outside/inside) for emergency operations and internal interaction.	**2.** Coordinate telephone and intercom needs with the installation.	
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Vinly asbestos tile. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation/attenuation for a nondisruptive environment.	**4.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .90, floor surface at NRC .50, and divider partitions (if used) at .85.	**4.** See reference 201, page 3-4, Table 3-2.
5. Adequate lighting.	**5.** Install artificial lighting unless natural light supplies the required levels of (from quantitative and qualitative evaluations): 20 to 30 footcandles general lighting. 60 to 80 footcandles task lighting. Surface reflectances: Ceiling--80 to 90 percent. Walls--40 to 60 percent. Floors--20 to 40 percent.	**5.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
6. Thermal comfort.	**6.** Temperature should be maintained at 68°F (heating), 78°F (cooling), with a 5 cubic foot per minute per person outside air ventilation rate.	**6.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Provide 120/208 electrical service. Install 120-volt receptacles at each workstation and workbench for convenience at the appropriate height and/or for every 10 linear feet of wall. Electrical power must fall within the 10,000- to 500,000-watt range, with frequency levels at 50 to 60 hertz ±5 percent.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumptions that this facility is windowless and houses critical equipment and data that would create a severe strategic fire loss potential.	**8.** Interior enclosure walls: 1-hour fire-rated construction. Interior doors: 20-minute fire-rated doors. Interior finish: Class A or B only. Automatic fire suppression: Water sprinklers. Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



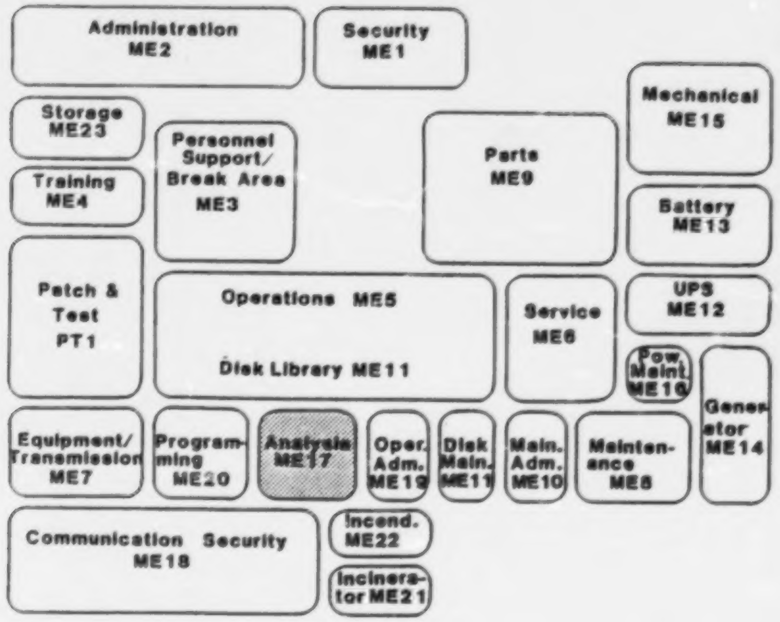
10-- speaker in ceiling

guidance

5. Work area

Light fixtures that provide uniform light intensity should be equipped with light-control lenses or specular parabolic louvers to minimize glare on working surfaces. The work area also should have adjustable task lighting.

ANALYSIS ME17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Incend. ME22
Incinerator ME21

function

To support personnel who record and analyze information generated by the communication equipment.

policy/sop

1. Due to the sensitive material generated through the analysis function, security for this activity is very important. Policy measures include lockable doors for times when the module is unstaffed and space sanitization after each shift.

issues and assumptions

activities

1. Recording information generated by the communication equipment (journal entries).
2. Typing.
3. Filing.
4. Sanitizing after each shift.

personnel

1. Four.

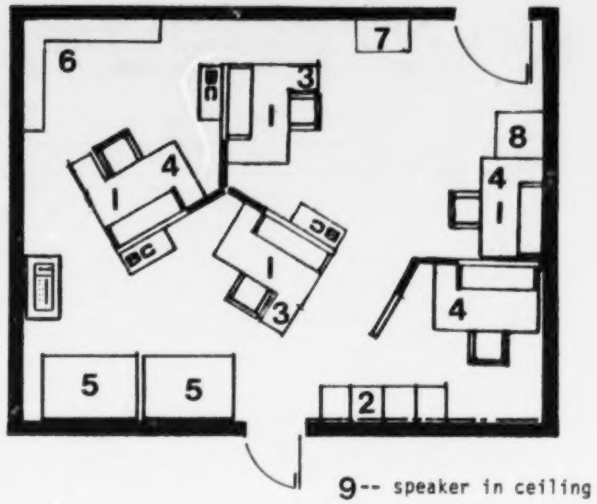
equipment *

1. Four desks with chairs.
2. Four filesafes.
3. Typewriters/word processors with stand(s).
4. Telephones.
5. Two tables.
6. Shelving (20 linear feet) for books and other materials.
7. Cabinet for internal paperwork.
8. Two cabinets, 12 by 24 by 16 inches (lockable for classified documents).
9. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate the equipment and furniture associated with the analysis function.	**1.** Provide 120 square feet each for four analysis personnel.	
2. Security.	**2.** The facility must be lockable and unstaffed and must have an intrusion alarm system.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation/attenuation for a nondisruptive environment.	**4.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**4.** See reference 201, page 3-4, Table 3-2.
5. Adequate lighting.	**5.** General: 20 to 50 footcandles. Task: 70 to 150 footcandles (adjustable fixtures). VDT: 5 to 10 footcandles. Surface reflectances Ceiling: 80 to 90 percent. Walls: 30 to 80 percent (wall at person's back should be 10 to 20 percent).	**5.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
6. Thermal and occupant comfort.	**6.** Temperature should be maintained at 68°F (heating), 78°F (cooling), with a 5 cubic foot per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent backrest adjustment.	**6.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Provide 120/208 electrical service. Install 120-volt receptacles at all workstations for convenience at the appropriate height and/or for every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ±5 percent.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumptions that this facility is windowless and houses critical equipment and data that would create a severe strategic fire loss potential.	**8.** Interior finish: Class A or B only. Automatic fire suppression: Water sprinklers. Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location

- Direct access to operations.
- Direct access to intelligence officer.
- Direct access to shredder.

5. Lighting design

To reduce glare at VDTs, equip fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1½ x 1½ inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver also may be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values.

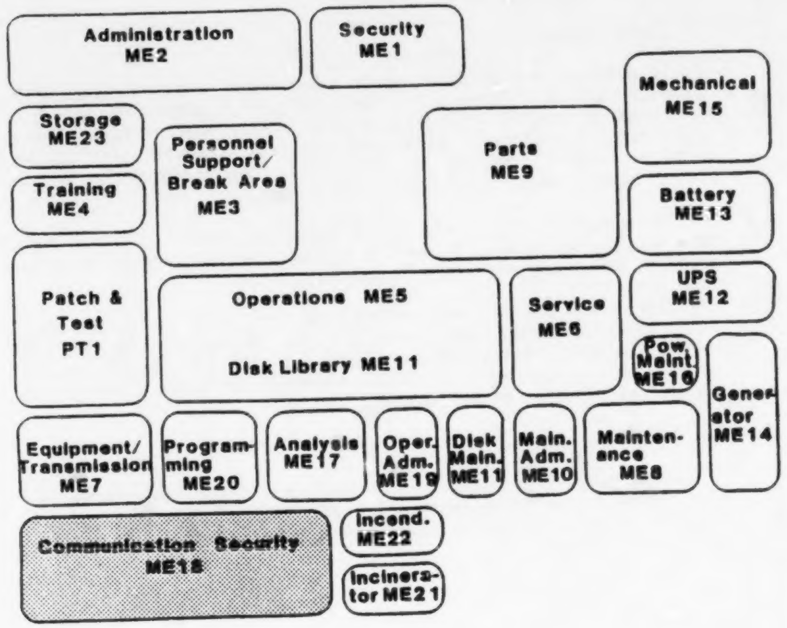
The suggested cell size for a parbolic louver is 1 x 1 inch down to ½ x ½ inch. On tall ceilings, the cell depth must be greater, which may dictate a larger cell size.

Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting also is recommended for noise control and virtual elimination of reflections.

6. Electrical power

Floor-to-ceiling poles to distribute electrical and communication lines to workstation modules are recommended to eliminate floor wires at circulation paths and to make future module modifications at minimal cost.

COMMUNICATION SECURITY ME18


Administration ME2
Security ME1
Mechanical ME15
Storage ME23
Personnel Support/ Break Area ME3
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Training ME4
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Operations ME5
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Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

To contain the cryptographic function, shredding bay, and security office. These spaces are all related to maintaining the security of classified information generated by the communication facility.

policy/sop

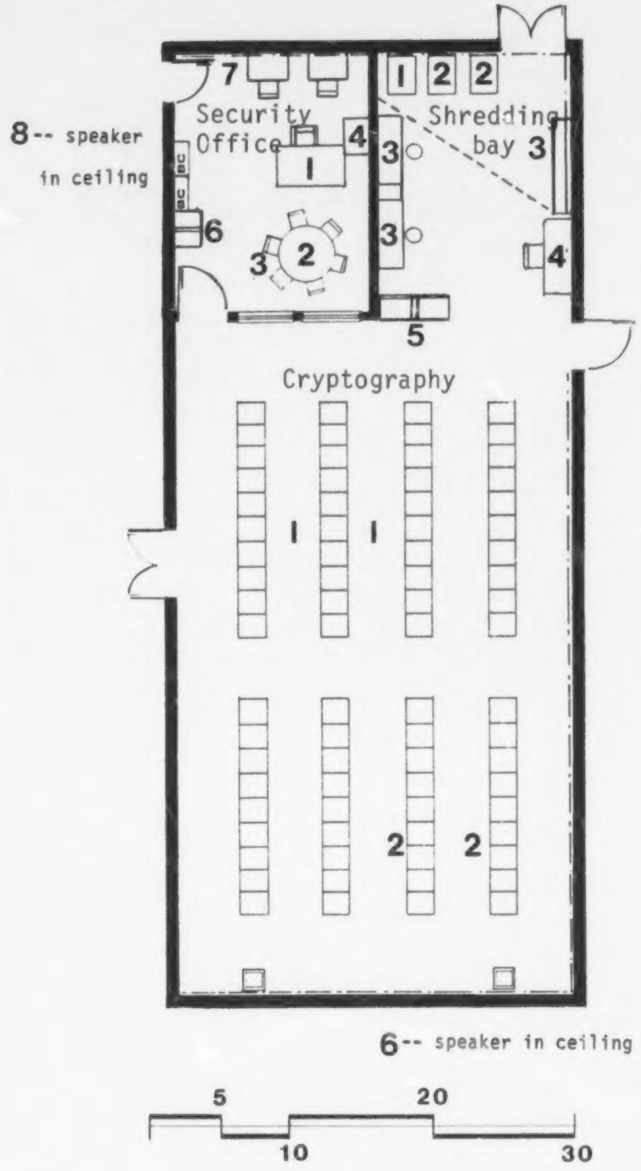
issues and assumptions

activities	**personnel**	**equipment ***
Cryptography 1. Decrypting information. 2. Maintaining CRYPTO equipment.	1. One or two. 2. Two mainenance personnel for CRYPTO equipment.	**1.** CRYPTO equipment. **2.** Multiplex unit. **3.** Two workbenches. **4.** Desk with chair. **5.** Filesafe. **6.** Intercom speaker.
Shredding bay 1. Shredding classified and other sensitive material.	1. One or two.	**1.** Pulp shredder. **2.** Waste disposal carts. **3.** Shelving (for material to be shredded).
Security office 1. Administering intelligence information. 2. Writing reports. 3. Filing. 4. Briefing personnel.	1. Security officer (SSO). * See "guidance" box for example layout of all equipment listed.	**1.** Desk with chair. **2.** Table for small briefings. **3.** Chairs for visiting personnel (four). **4.** Typewriter/word processor with stand. **5.** Telephone. **6.** Two filesafes. **7.** Shelving for publications. Intercom speaker.

requirements	criteria	commentary
1. Enough space to accommodate the cryptic function.	1. Provide approximately 1500 square feet for two personnel and the required cryptography equipment.	
Enough space to accommodate the shredding function.	Provide approximately 300 square feet for two personnel and a pulp shredder with waste receptacle.	
Enough space to accommodate the security officer and visiting personnel.	Provide approximately 300 square feet for a table with chairs, a desk, and two filesafes.	
2. Security.	2. Module must be lockable when unstaffed.	2. See Vol 2, SB7, Security (Zone 3), for more information.
3. Communication lines for emergency operations.	3. Coordinate the telephone system with key lines (predesignated personnel).	
4. TEMPEST shielding.	4. Electrical and electronic equipment must be shielded to prevent it from propagating interference and to protect it from the effects of interference propagated by other electronic devices. (15a) 7	4. See Vol 2, SB4, Grounding, Bonding, and Shielding, along with SB7, Security Systems, for more information.
5. EMP/HEMP shielding.	5. Shielding is necessary for survivability and uninterrupted functioning should the facility be subjected to electromagnetic pulse and high altitude electromagnetic pulse. Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	5. See Vol 2, SB5, EMP/HEMP Protection, for more information.
6. Interior finishes suitable for durability, maintenance, and room function.	6. Floor--Vinyl asbestos tile and wall-to-wall carpet in main traffic areas. A raised floor system shall be used over a concrete floor that has a dusted-on finish containing a hardener. See Vol 2, SB2, Interior Construction. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster, and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	6. See also Vol 2, SB2, Interior Construction and Finishes.
7. Acoustical isolation/attenuation for variable noise levels produced by electronic equipment.	7. Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), and floor surface at NRC .25 (minimum). Acoustic tile also is required to within 4 feet of the floor.	

requirements	criteria	commentary
8. Adequate lighting.	**8.** Ambient: 60 footcandles by fluorescent fixtures. Task: 100 footcandles.	
9. Thermal comfort.	**9.** Temperature should be maintained at 68°F (heating), 78°F (cooling), with a 5 cubic foot per minute per person outside ventilation rate.	**9.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
10. Electrical power.	**10.** Provide 120/208 electrical service. Install 120-volt receptacles at all workstations and workbenches at a convenient height and/or for every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ±5 percent.	**10.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumptions that this facility is windowless and houses critical equipment and data that would create a severe strategic fire loss potential.	**11.** Vaulted enclosure walls: Shielded, 2-hour (minimum) fire-rated construction. Interior doors in vaulted walls: 1½-hour fire-rated doors; shielded doors and frames. Interior finish: Class A or B only. Automatic fire detection: Local alarm. Automatic fire suppression: Water sprinklers. Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area: Automatic fire detection--local alarm. Automatic Halon 1301 suppression system if cross-zoned or matrix detection is required. Sprinkler and Halon systems usually are not installed in the same area.	**11.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance

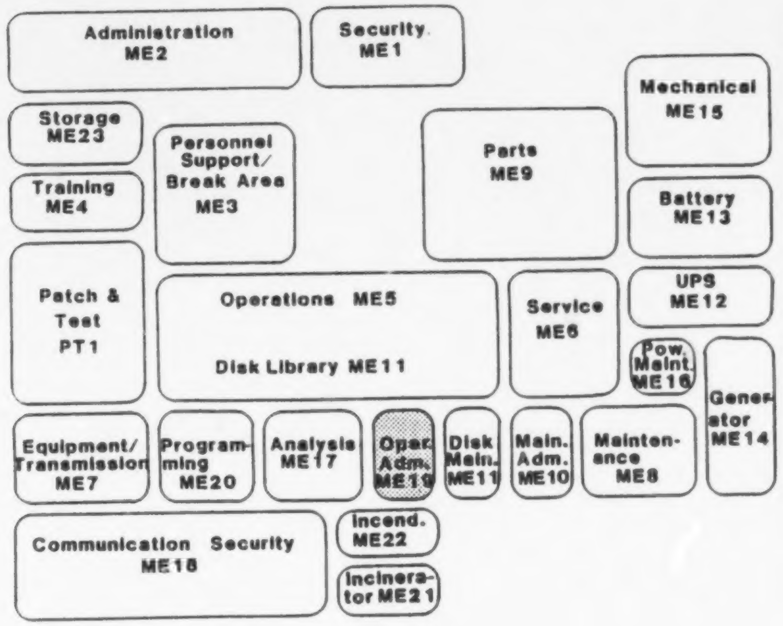

7
Security Office
4
1
6
2
3
8-- speaker in ceiling
1
2
2
Shredding bay
3
3
3
4
5
Cryptography
1
1
2
2
6-- speaker in ceiling
5
20
10
30

guidance

guidance

guidance

OPERATIONS ADMINISTRATION ME19


Administration ME2
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Equipment/ Transmission ME7
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Oper. Adm. ME19
Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

To provide administration space that specifically supports operations.

policy/sop

issues and assumptions

1. Enclosed office versus open area workstation

Present noncommissioned officers in charge (NCOICs) and the assistants usually occupy an office workstation in the operations room itself. This makes their work more difficult because of the high noise and activity levels. If an enclosed office is provided, a view window to the console area must be provided.

activities

1. Distributing directives, orders and policy statements both written and verbal, to shift supervisors.
2. Initiating evaluation of equipment capabilities.
3. Developing personnel training plans and equipment evaluations.
4. Conferring with personnel (one-to-one).
5. Writing and typing reports.
6. Communicating operations and service functions.
7. Managing the operations function.
8. Planning for exercises and contingencies.

personnel

1. NCOIC and chief-in-charge.
2. Operations NCOIC.

equipment *

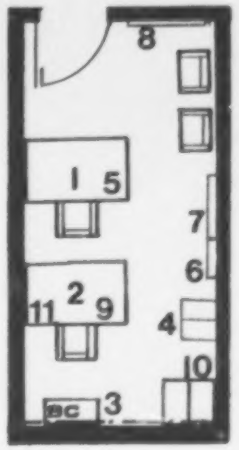
1. NCOIC workstations: desk/chair in open area (or with dividers).
2. Operations NCOIC workstation: desk/chair in open area (or with dividers).
3. Bookshelves--20 linear feet.
4. Four files, five drawers each.
5. Typewriter(s) with stand(s).
6. Tackboard.
7. Scheduling board and multiboard.
8. Station log.
9. Telephones.
10. Filesafe, five drawers.
11. Operational voice intercom control.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate the equipment and furniture associated with the administrative function.	**1.** Provide approximately 150 square feet.	
2. Visual contact from offices to the operations floor to provide management with better opportunities to optimize personnel effectiveness.	**2.** Locate the administrative office space adjacent to the operations center console.	
3. Communication lines (outside and inside) for emergency operations and internal interaction between offices and operations floor.	**3.** Coordinate telephone and intercom needs with the installation.	
4. Interior finishes suitable for durability, maintenance, and room function.	**4.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**4.** See also Vol 2, "Site and Building Information," SB2, Interior Construction and Finishes.
5. Aoucstical isolation and attenuation for a nondisruptive environment.	**5.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .90, floor surface at NRC .50, and divider partitions (if used) at .85.	
6. Adequate lighting.	**6.** Use artificial lighting or natural if present. By quantitative and qualitative evaluation, provide: 20 to 30 footcandles general lighting 60 to 80 footcandles task lighting. Surface reflectances: Ceiling--80 to 90 percent Walls--40 to 60 percent Floors--20 to 40 percent.	**6.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical Lighting.
7. Thermal comfort.	**7.** Regulate temperature at 68°F (heating), 78°F (cooling), with a 5-cubic feet per minute per person outside air ventilation rate.	**7.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
8. Electrical power.	**8.** Install 120/208 electrical service. Receptacles (120-volt) should be located for convenience at each workstation and workbench at a suitable height for every 10 linear feet of wall. Electrical power must fall within the 10,000- to 500,000-watt range. Frequency levels should be at 50 to 60 hertz ± 5 percent.	**8.** See also Vol 2, SB2, Communication Station Buildings--Electrical.

requirements	criteria	commentary
9. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe fire loss potential.	**9.** Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**9.** See Vol 2, Standardized Modules--Building Design Principles, and SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

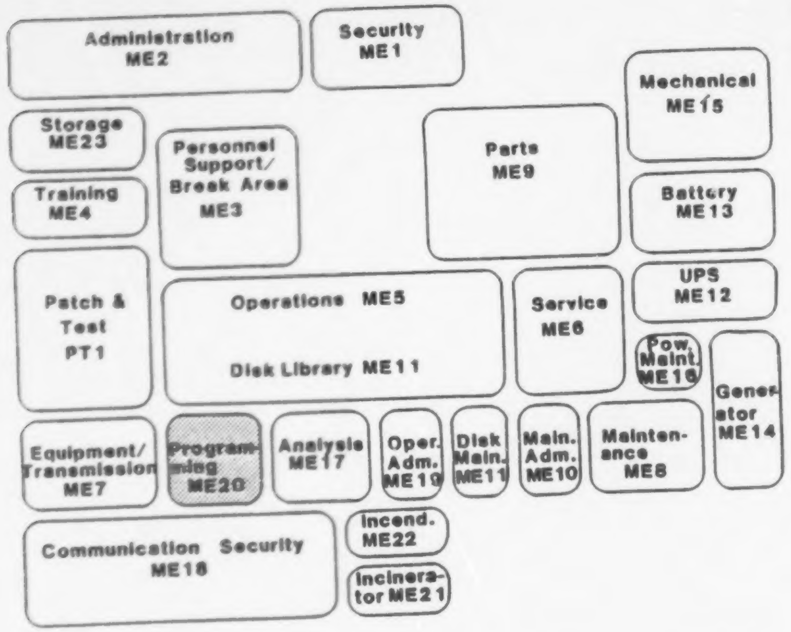
6. Work area

Light fixtures that provide uniform intensity should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. The work area should also be provided with adjustable task lighting.

guidance

guidance

PROGRAMMING ME20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Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Incend. ME22
Communication Security ME18
Incinerator ME21

function

To support the computer programmers who develop and maintain the software used in the AUTODIN equipment.

policy/sop

issues and assumptions

activities

1. Writing computer programs.
2. Reading computer printouts (hard copy).
3. Typing reports.
4. Storing computer printouts (hard copy).
5. Storing magnetic tapes.
6. Storing computer cards.

personnel

1. Three.

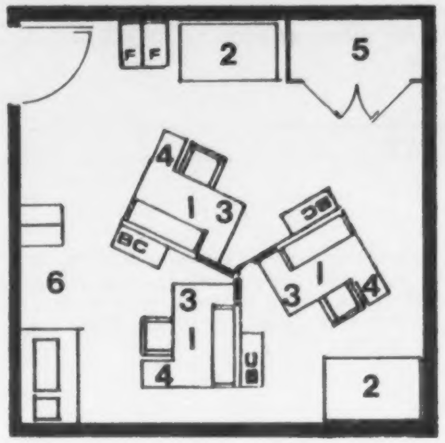
equipment *

1. Three desks with chairs.
2. Three tables.
3. Telephone.
4. Two typewriters/word processors with stands.
5. Cabinet with shelving for tapes, cards, and printouts.
6. Two filesafes.
7. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate the equipment and furniture associated with the programming function.	**1.** Provide approximately 110 to 130 square feet for each workstation.	
2. Security for classified information.	**2.** The module must be lockable when unstaffed.	**2.** See Vol 2, SB7, Security (Zone 3) for more information.
3. Intrusion alarm system.	**3.** Install an alarm system.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Interior finishes suitable for durability, maintenance, and room function.	**4.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	
5. Acoustical isolation/attenuation for a nondisruptive environment.	**5.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .90, floor surface at NRC .50, and divider partitions (if used) at .85.	**5.** See reference 201, page 3-4, Table 3-2.
6. Adequate lighting.	**6.** General: 20 to 50 footcandles. Task: 70 to 150 footcandles (adjustable fixtures). VDT: 5 to 10 footcandles. Surface reflectances: Ceiling--80 to 90 percent. Walls--30 to 80 percent (wall at person's back should be 10 to 20 percent). Floor--15 to 40 percent.	**6.** For further information on lighting design quality using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
7. Thermal and occupant comfort.	**7.** Temperature should be maintained at 68°F (heating), 78°F (cooling), with a 5 cubic foot per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent backrest adjustment.	**7.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
8. Electrical power.	**8.** Provide 120/208 electrical service. Install 120-volt receptacles at all workstations and workbenches at a convenient height and/or for every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ±5 percent.	**8.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
9. Fire protection/life safety criteria are based on the assumptions that this facility is windowless and houses critical equipment and data that would create a severe strategic fire loss potential.	**9.** Interior finish: Class A or B only. Automatic fire suppression: Water sprinklers. Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**9.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



7-- speaker in ceiling

guidance

5. Acoustical visual privacy

Divider partitions between workstations should be 60 inches high (±4 inches) to provide visual privacy while occupants are seated--yet not be confining. Circulation paths around workstations should minimize the disturbance to other workstations.

6. Lighting design

To reduce glare at VDTs, equip fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1½ x 1½ inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver also may be helpful. Some pigmented arcylic lenses and nonparabolic metal louver panels can also give high VCP values.

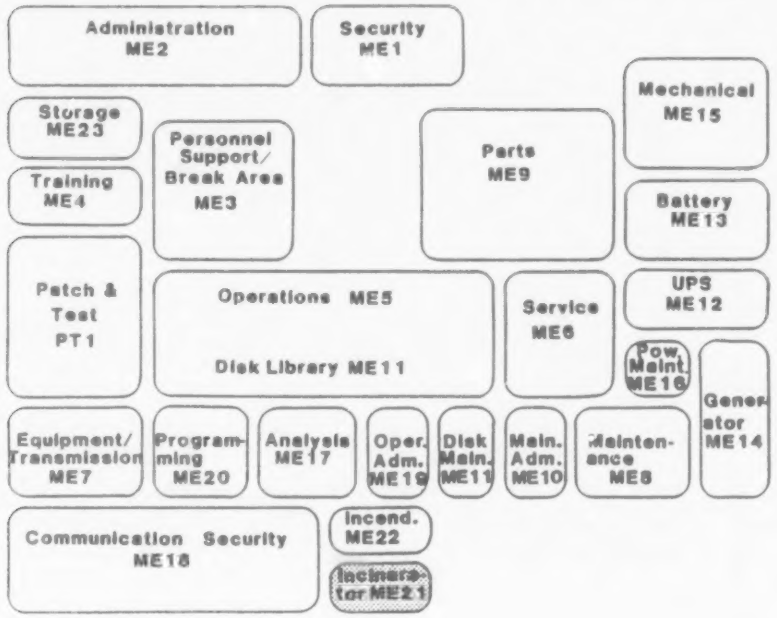
The suggested cell size for a parabolic louver is 1 x 1 inch down to ½ x ½ inch. On tall ceilings, the cell depth must be greater, which may dictate a larger cell size.

Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting also is recommended for noise control and virtual elimination of reflections.

Electrical power

8. Floor to ceiling poles that distribute electrical and communication lines to workstation modules are recommended for use to eliminate floor wires on circulation paths and to enable future module modifications at minimal cost.

INCINERATOR ME21


Administration ME2
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Main. Adm. ME10
Mainten-ance ME8
Communication Security ME18
Incend. ME22
Incinera-tor ME21

function

To enable the DCS facility to dispose of all classified and other sensitive material generated daily by AUTODIN activities.

policy/sop

1. The sensitive information generated by DCS communications must be destroyed immediately (daily). The volume of material requires on-site incineration to minimize security risks. Most sensitive material comes from the operations (ME5) and communication security (ME18) spaces.

issues and assumptions

1. Air pollution abatement

Incineration units must provide for the complete combustion necessary to reduce smoke and odor to required levels. When very strict emission controls are required, flue gas particulate (fly ash) can be removed with a water-spray wash.

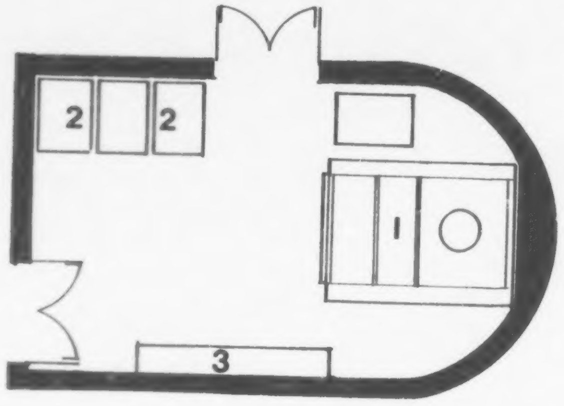
2. Heat recovery system

If the amount of paper material to be burned is extensive, an analysis should be made to determine the life-cycle value of using the heat generated by the burning process to contribute to domestic hot-water and space-heating requirements. Most large incinerators have adaptation kits that allow for heat recovery systems.

activities	personnel	equipment
1. Burning classified and other sensitive material.	1. One.	**1.** Incinerator, 88 by 60 inches. **2.** Waste disposal carts. **3.** Shelving for material to be burned.

requirements	criteria	commentary
1. Enough space to accommodate the incineration equipment requirements associated with burning sensitive material.	**1.** Provide approximately 300 square feet.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation for variable noise levels produced by mechanical equipment.	**3.** Adjacent room walls should limit sound transmission to 40 decibels.	
4. Fuel for starting and completing combustion.	**4.** Both gas and oil fire burners are available but gas usually is the best choice.	
5. Adequate lighting.	**5.** Ambient: 30 footcandles by fluorescent fixtures.	
6. Thermal comfort.	**6.** Temperature should be maintainable at 50°F (heating).	**6.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Provide 120/208 electrical service. Install 120-volt receptacles at all workbenches at a convenient height and/or for every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ±5 percent.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumptions that this facility is windowless and houses critical equipment and data that would create a severe strategic fire loss potential.	**8.** Vaulted enclosure walls: 2-hour fire-rated construction. Interior doors: 1½-hour fire-rated doors. Interior finish: Class A or B only. Automatic fire suppression: Water sprinklers. Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



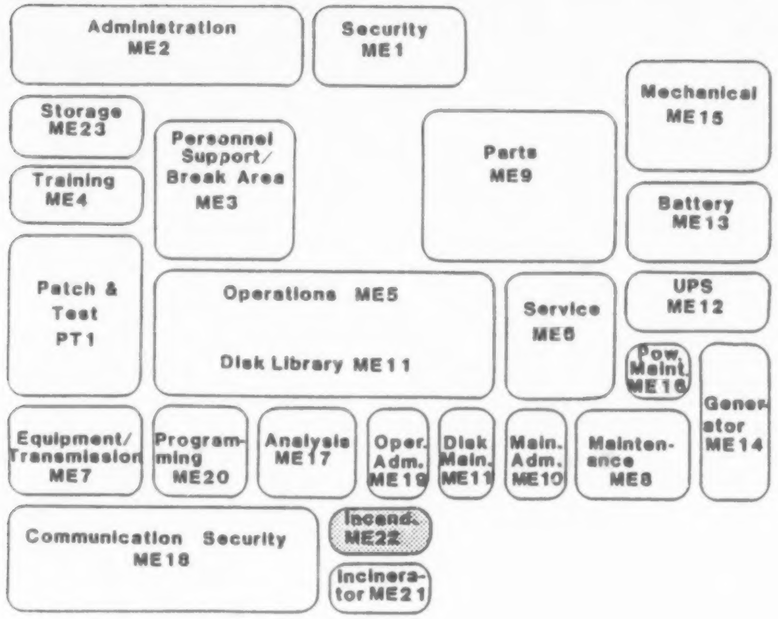
guidance

1. Location

Provide direct access from communication security (ME18) space.

An exterior "burn-pit" can be installed to increase the burning capability during emergencies. (See location recommended on the plan drawing in Standardized Modules, ME24.)

INCENDIARY SUPPLIES ME22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Oper. Adm. ME19
Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

To enable the DCS facility to destroy communication equipment and other sensitive material should the installation come under hostile attack.

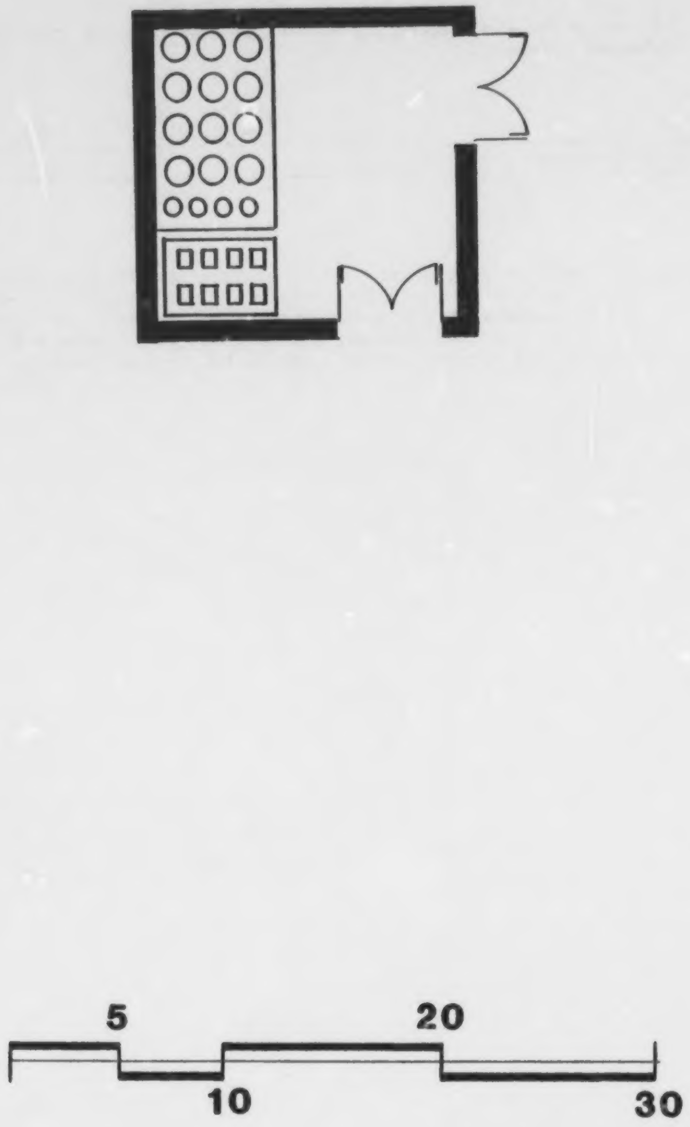
policy/sop

issues and assumptions	activities	personnel	equipment *
	1. Uncrating, storing and taking inventory of incendiary supplies.	1. As required.	1. Storage racks for incendiary items.
	2. Transporting incendiary items from storage to sensitive communication equipment.		

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate the incendiary items.	**1.** Provide approximately 200 to 250 square feet, depending on the number of supplies required.	
2. Blast containment structure.	**2.** Walls, doors, and roof structure to contain incendiary explosive or fire accidents.	
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation/attenuation for a nondisruptive environment.	**4.** Adjacent room walls should limit sound transmission to 40 decibels.	
5. Adequate lighting.	**5.** Ambient: 30 footcandles by fluorescent fixtures.	
6. Thermal comfort.	**6.** Temperature should be maintainable at 60°F (heating).	**6.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Provide 120/208 electrical service. Install 120-volt receptacles at all workbenches at a convenient height and/or for every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ±5 percent.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumptions that this facility is windowless and houses critical equipment and data that would create a severe strategic fire loss potential.	**8.** Interior enclosure walls; 2-hour fire-rated construction. Interior doors: 1½-hour fire-rated doors. Interior finish: Class A or B only. Automatic fire detection: Local alarm. Automatic fire suppression: Water sprinklers. Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location

Provide direct access to the outside.

The module also should be located for fast distribution of incendiary items to all communication equipment, especially in the communication security space (ME18).

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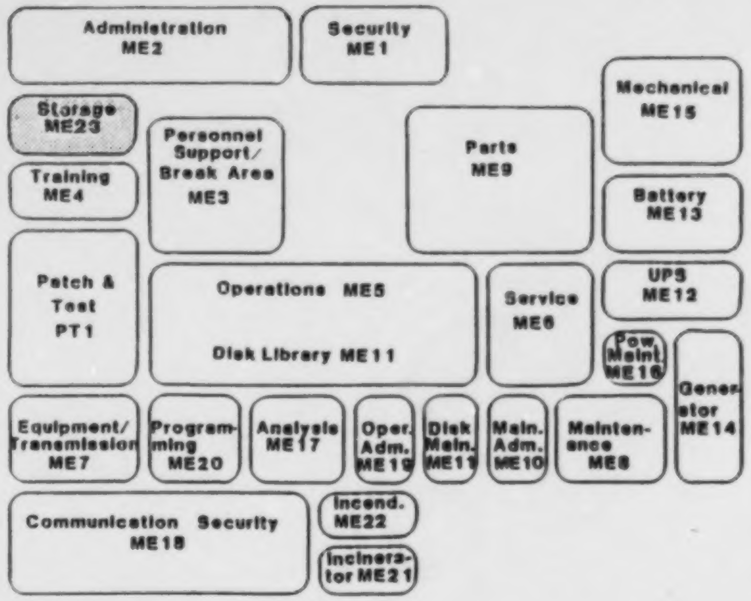
STORAGE ME23


Administration ME2
Security ME1
Storage ME23
Training ME4
Personnel Support/ Break Area ME3
Parts ME9
Mechanical ME15
Battery ME13
Patch & Test PT1
Operations ME5
Disk Library ME11
Service ME6
UPS ME12
Pow. Maint. ME16
Generator ME14
Equipment/ Transmission ME7
Programming ME20
Analysis ME17
Oper. Adm. ME19
Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

function

To provide for the temporary placement of miscellaneous items and non-technical equipment.

policy/sop

1. All services have physical fitness requirements that must be met annually. For remote DCS facilities with no installation services, it is recommended that exercise equipment be made available. The exacting, sometimes intense, activities of maintaining and controlling the DCS requires periodic breaks for physical exercise.

requirements	criteria	commentary
1. Enough space to accommodate two or three persons exercising, plus space to move about for shelving items.	**1.** Allow approximately 250 square feet to accommodate the exercise equipment plus 60 linear feet of shelf space.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	**3.** Adjacent room walls should limit sound transmission to 40 decibels.	
4. Adequate lighting.	**4.** Use 30-footcandle (ambient) fluorescent fixtures.	
5. Thermal comfort.	**5.** Regulate temperature at 68°F (heating), 78°F (cooling). Provide 10 cubic feet per minute per person outside air ventilation rate with on-off switching.	**5.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
6. Electrical power.	**6.** Install 120/208 electrical service. Provide 120-volt outlets--one receptacle for every 10 linear feet of wall. Frequency levels should be at 50 to 60 hertz ± 5 percent.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

issues and assumptions

1. Storage for exercise equipment

The exercise equipment should not conflict with the function of other personnel-oriented rooms. A general purpose storage room is suitable since the equipment is unofficial.

activities

1. Shelving of miscellaneous sized items.
2. Individual exercise.

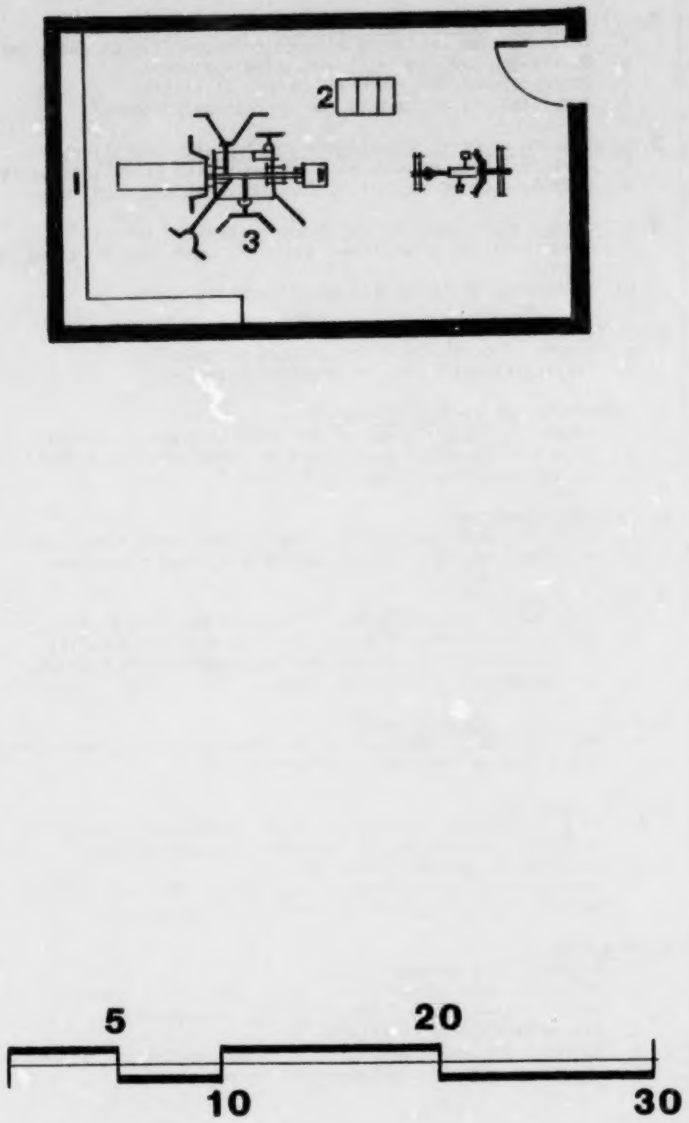
personnel

equipment*

1. Shelving 18 inches deep.
2. Small step ladder.
3. Exercycle, universal gym, and/or loose weights.

* See "guidance" box for example layout of all equipment listed.

guidance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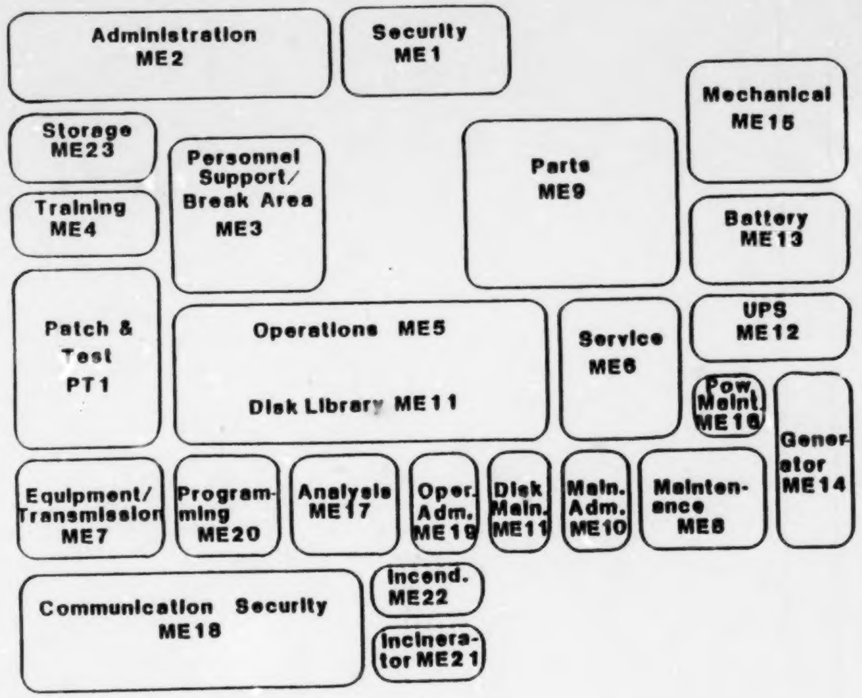
guidance

STANDARDIZED MODULES ME 24


Administration ME2
Security ME1
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Disk Main. ME11
Main. Adm. ME10
Maintenance ME8
Communication Security ME18
Incend. ME22
Incinerator ME21

building design principles

1. Efficiency of operational functions
   a. Communication equipment aligned for surveillance and access.
   b. On-the-job training with operating equipment.
   c. Interaction of operational support activities.
   d. Accessibility of toilets for operations personnel.

2. Integration of parts/maintenance modules with operations
   a. Parts/maintenance modules contiguous with operations spaces.
   b. Loading dock accessibility for equipment and supplies.

3. Efficiency and accessibility of administration spaces
   a. Administration transition space between public areas and secure spaces.
   b. Efficiency of integrated administrative spaces.

4. Personnel support spaces
   a. Change of environment for on-duty personnel.
   b. Facilities available for physical training.

5. Integration of power/UPS modules
   a. Economies and efficiencies of integrated power modules.
   b. Minimized impact of generators on communications transmissions.
   c. Economical battery room ventilation.

6. Facility expansion
   a. Expansion potential in new construction operations space.
   b. Minimized impact of future operations space expansion.

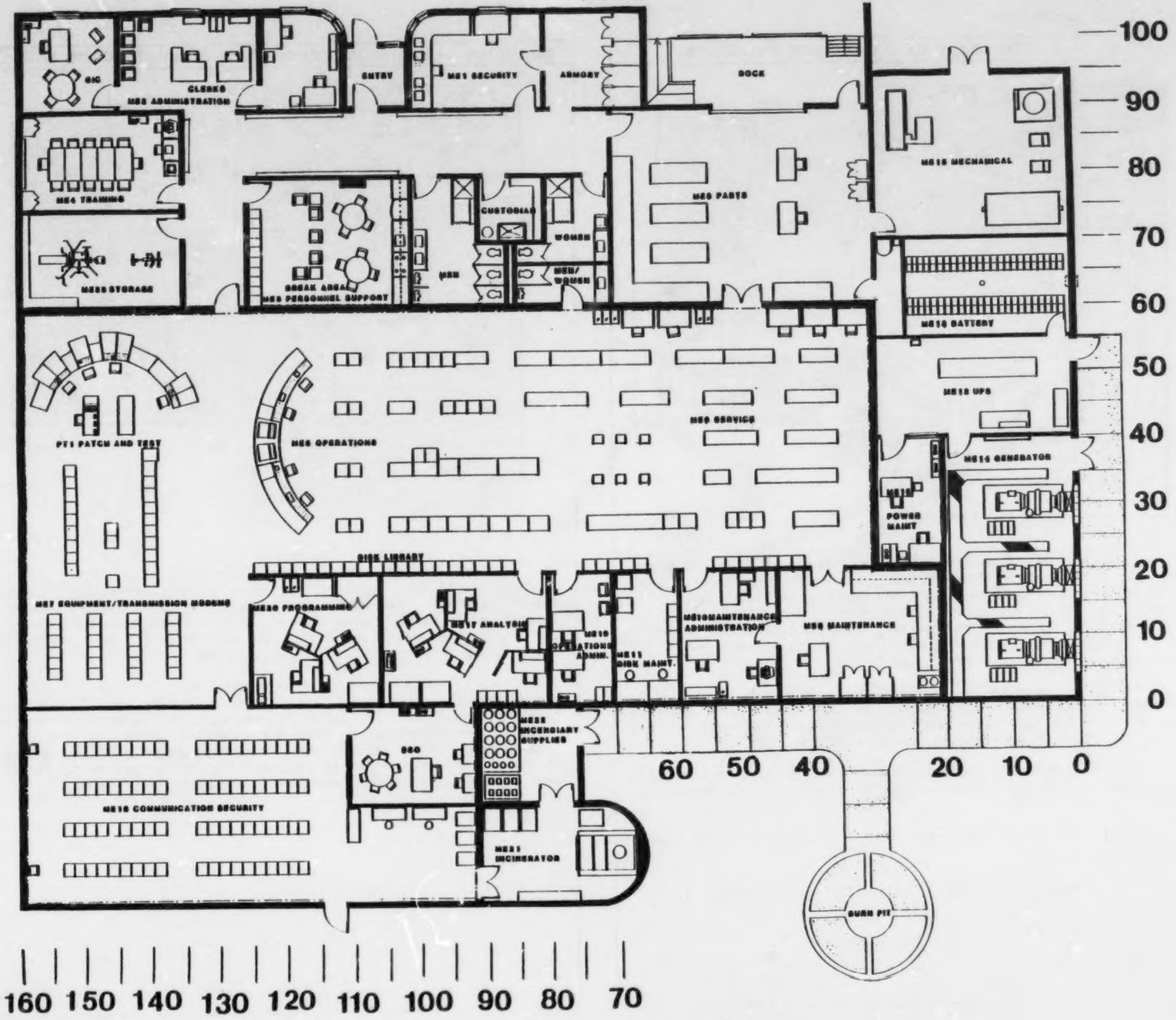
7. Security operation
   a. Location of security space to control building access.
   b. Central monitoring of total site and building security.
   c. Message security in operations and cryptography modules.
   d. Limited access into secure areas.

8. Facility security/survivability
   a. Required vault construction for communication system equipment.
   b. Protection of the communication signal.

9. Fire protection
   a. Fire protection classifications: occupancy, hazard of contents, sprinkler protection, and construction/materials.
   b. Building separation distances.
   c. Fire protection systems: automatic fire suppression, automatic notification/alarm, and automatic fire detection.

10. Life Safety
    a. Occupant load determination.
    b. Protected exit conditions: exit capacities, number of exits, exit travel distances, and means of exit arrangement.
    c. Allowable interior finishes.
    d. Egress path identification: illumination of means of egress, emergency lighting, and means of egress marking.

ME-117


OIC
CLERKS
ME2 ADMINISTRATION
ENTRY
ME1 SECURITY
ARMORY
DOCK
ME4 TRAINING
ME23 STORAGE
BREAK AREA
ME3 PERSONNEL SUPPORT
MEN
CUSTODIAN
WOMEN
MEN/WOMEN
ME6 PARTS
ME15 MECHANICAL
ME16 BATTERY
ME12 UPS
ME14 GENERATOR
ME13 POWER MAINT
PT1 PATCH AND TEST
ME5 OPERATIONS
ME9 SERVICE
DISK LIBRARY
ME7 EQUIPMENT/TRANSMISSION MODEMS
ME20 PROGRAMMING
ME17 ANALYSIS
ME19 OPERATIONS ADMIN.
ME11 DISK MAINT.
ME10 MAINTENANCE ADMINISTRATION
ME8 MAINTENANCE
ME22 INCENDIARY SUPPLIES
SSO
ME18 COMMUNICATION SECURITY
ME21 INCINERATOR
BURN PIT
100
90
80
70
60
50
40
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0
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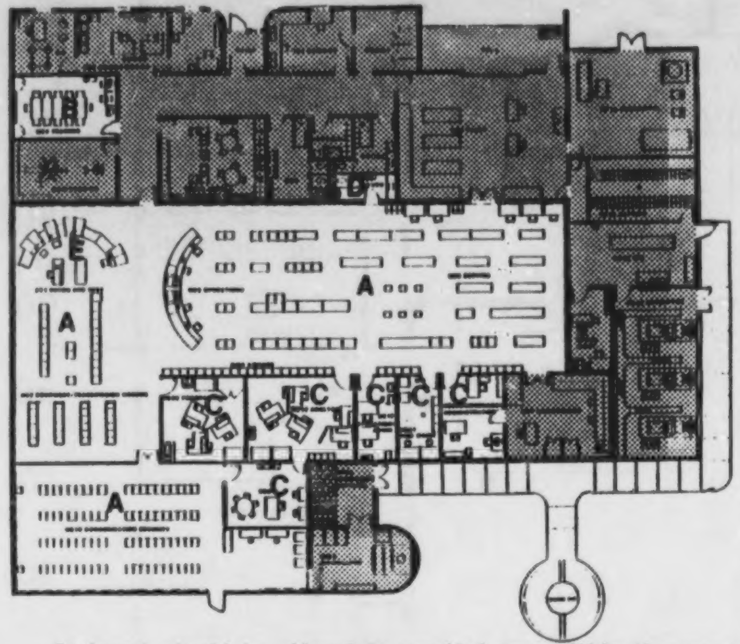
guidance 1. Efficiency of Operational Functions



A. Equipment should be aligned in parallel rows within the operations modules for ease in visual surveillance and to provide direct access to all critical equipment. Multiple consoles should be adjacent to each other so that limited personnel can monitor them efficiently at one central location. Tables for audiovisual training aids should be available in operations modules so that personnel can train on-the-job during regular watch periods.

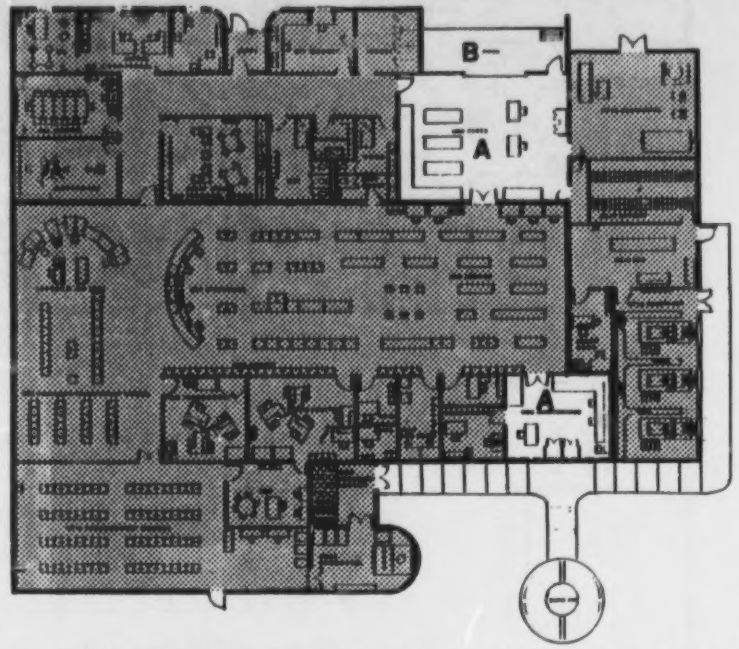
B. To further enhance the effectiveness of on-the-job training, instruction can be done in small groups of four or five in a training room for hands-on experience with communications equipment. This requires a close relationship with the operations module.

C. Additional building modules with a close functional relationship to operations activities should be located adjacent to the operations module.

D. Toilet facilities should be nearby for personnel in the operations module.

E. See technical control module information in section TC, Vol 1B.

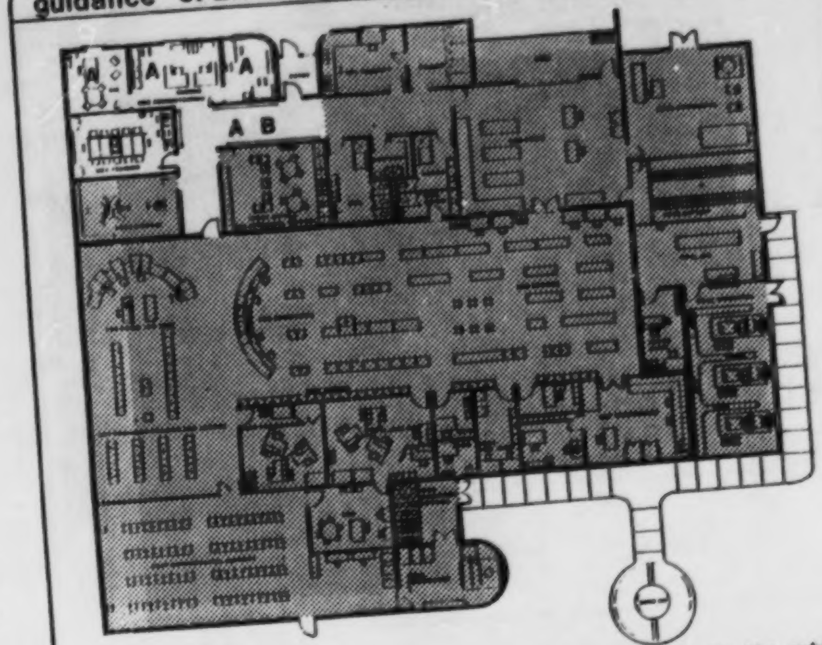
guidance 2. Integration of Parts/Maint. Modules with Ops.



A. Parts and maintenance modules should be well integrated and contiguous with the operations spaces to optimize efficiency and minimize circulation. The secure door between the operations and the maintenance/parts spaces is used only as a fire exit and to bring communication equipment in from and out to the loading dock. This door should have opening hardware only on the secure side.

B. Parts and maintenance from modules must be located within an organizational context such that deliveries can be made to the total building in a direct and secure process at a loading dock. The large communication equipment can be moved in and out more easily using the loading dock. (Also, in multistory communication buildings, an elevator should be located adjacent to the parts module for safe vertical movement of large communication equipment throughout the building.)

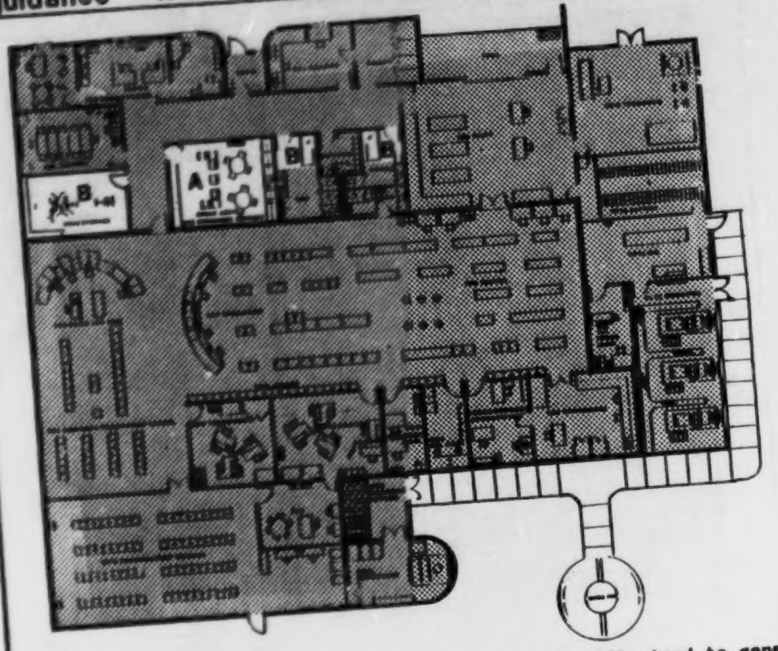
guidance 3. Efficiency and Accessibility of Admin. Spaces



A. Administration modules must be easily accessible to the public to minimize circulation and to prevent visitor interference with facility operations. The administration modules should provide a buffer and transition space between the exterior and interior secure spaces. Also, public corridors in the administration area should contain military unit logos and other display panels that relate to the "esprit de corps" and unit integrity of the communication station.

B. Administration spaces' integrated relationship will improve efficiency by minimizing public and administrative circulation and by producing a group adjacency to shared conference areas, secretaries, and waiting areas.

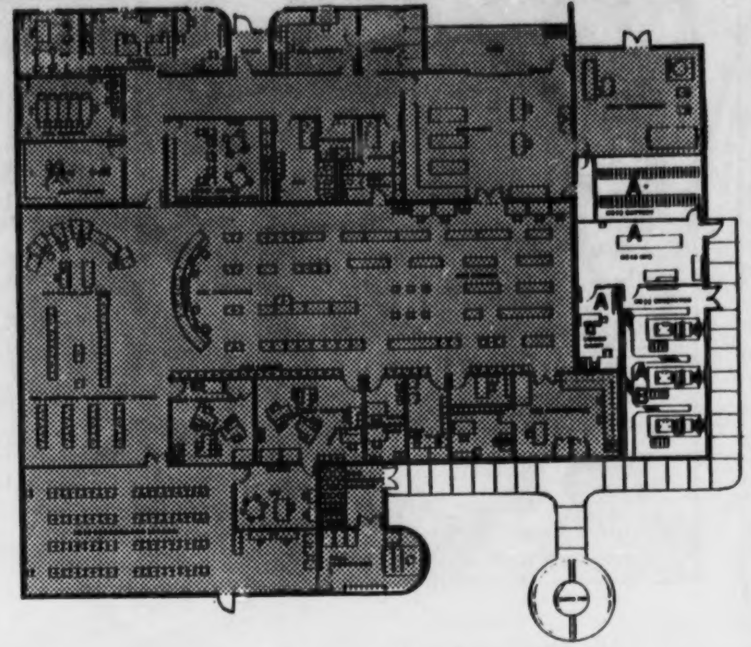
guidance 4. Personnel Support Spaces



A. The intense activities inside the DCS facility tend to generate mental fatigue among personnel. It is therefore necessary to create a change of environment for on-duty personnel to provide a break from the "hard surface" equipment room and work areas. The personnel support module should be directly adjacent to the operations room, but isolated acoustically and visually.

B. In addition, physical exercise equipment is recommended for DCS facilities located off military bases. The necessary showers and lockers should be similarly adjacent to the operations module for easy access and optimal use.

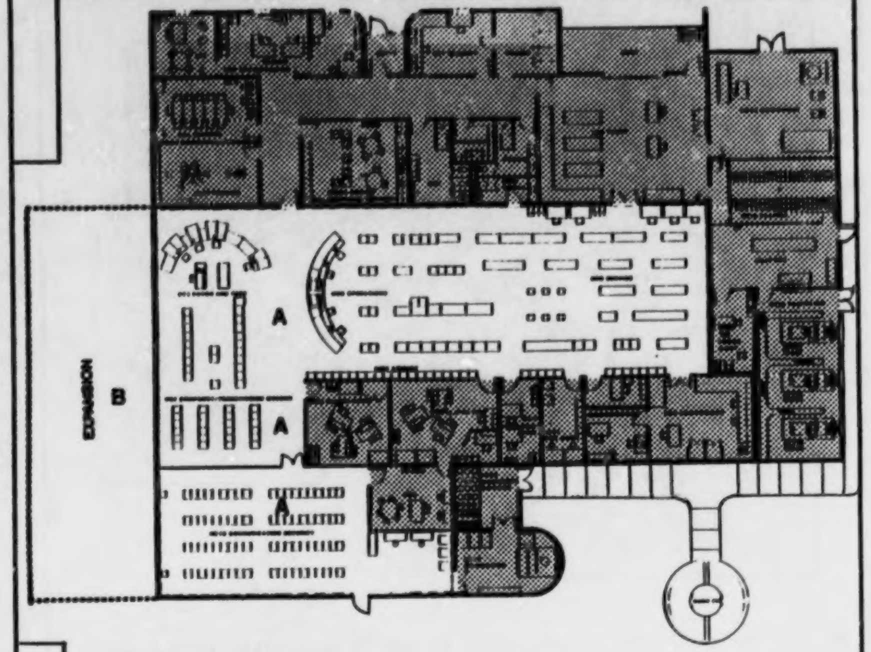
guidance 5 Integration of Power/UPS Modules



A Modules that comprise the power and UPS gear should be contiguous and well integrated together. Direct physical adjacencies will provide economy by minimizing cable lengths and produce personnel efficiency resulting from inter-access relationships.

B Confining the power and UPS spaces to remote area will minimize the impact of generator vibrations that may adversely affect the communications transmissions.

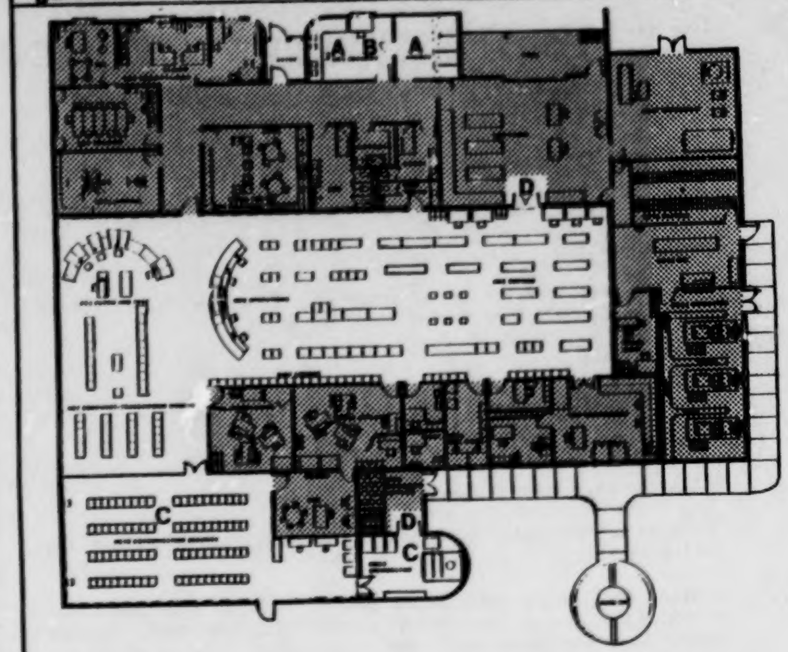
guidance 6 Facility Expansion



A The equipment layout should be planned in such a manner as to afford sufficient space for the installation of equipment capable of handling the maximum projected traffic load. The initial equipment layout should be such that ultimate expansion of the station facility can be accomplished without extensively rearranging already installed equipment. Allowance of space for future equipment can be determined if specific equipments for future installation are known; otherwise, an estimate based upon the requirements of similar equipments should be made. In a new communications facility, a 100% equipment expansion is reasonable.

B Operations modules should be functionally isolated from support and power modules. Due to the increasingly rapid changes in the technology of communications, new demands on the spatial layout of Operations modules can be expected in the future. Such spaces must have the capability to expand to accommodate new equipment and new functions. It is not anticipated that support and power spaces will need this same expansion capability and therefore may be located in their own areas; i.e., facility design should allow Operations modules to expand without significantly affecting the remaining functions.

guidance 7. Security Operation



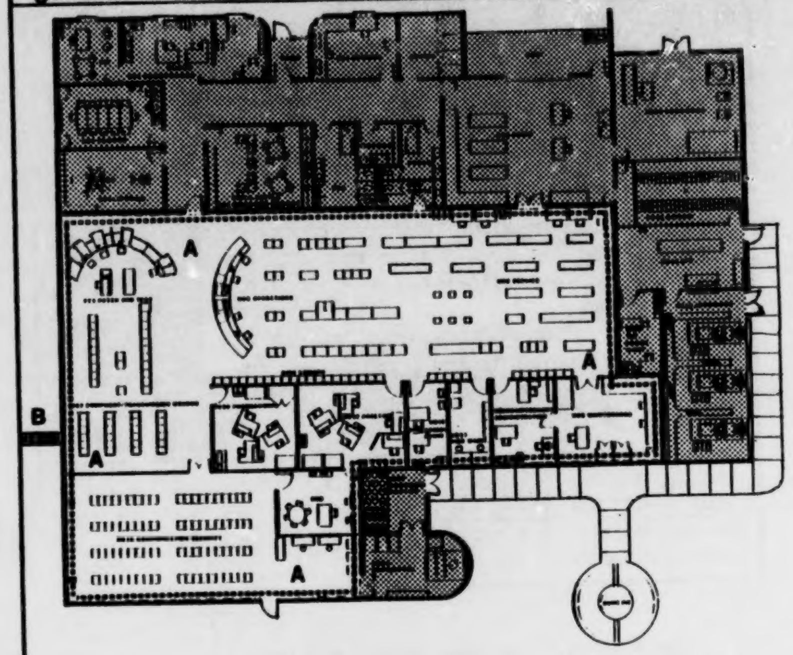
A Security modules should be located to provide overview for entry verification of visiting personnel. Additionally this module must be easily accessible to building occupants to facilitate the efficient storage and distribution of personnel weapons.

B The Security module will administrate site security, monitor all intrusion detection systems, and initiate appropriate reactions to hostile threats. The Security module should therefore be designed to provide overview and control over site access and all exterior activities.

C "Message" security is accomplished by minimizing circulation between operations and cryptography modules, confining the modules to controlled areas, and by providing disposal techniques performed or controlled by appropriate personnel.

D Required doors from other interior modules (or from the outside) that open into secure areas should have opening hardware only on the secure side.

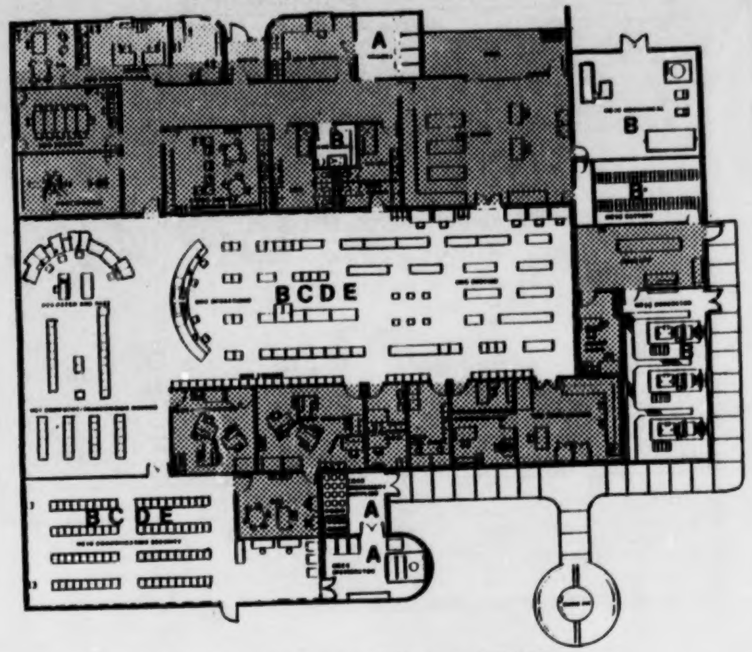
guidance 8. Facility Security/Survivability



A Conventional Class A vault construction is required for all those spaces containing the communication system equipment; such as Operations, Equipment and Tech Control. Therefore efficient construction methods and future building flexibility requirements can be met by locating these spaces in a contiguous relationship. These spaces usually require the vault-type construction for a combination of four requirements: 1) HEMP protection, 2) TEMPEST shielding, 3) building intrusion resistance and 4) fire protection. (See SB-7 Security Systems--guidance for building security construction of Zone 4, Section 5b).

B Communication facilities require the use of waveguides in transporting the communications signal to and from the antennas to the transmission/receiving equipment. It is necessary therefore that the transmission/receiving module be located at a minimal distance from the antennas. Additionally, waveguides must be physically protected to ensure the facility's capability of performing its mission.

guidance 9. Fire Protection



Occupancy classifications: Business (NFPA); B-2 (UBC)

Hazard of contents classification: Ordinary hazard

Sprinkler protection classification: Ordinary hazard--group 2.

Construction classifications/materials for fire protection (See Vol 2, the first figure in SB3, Fire Protection/Life Safety)

A. Type II--fire resistive (UBC) for security/armory spaces:

Construction Element	
Exterior walls	4-hour rated construction
Interior bearing walls	2-hour rated construction
Structural frame	2-hour rated construction
Permanent partitions	1-hour rated construction
Shaft enclosures	2-hour rated construction
Floors	2-hour rated construction
Roofs	2-hour rated construction

B. Type II--One-Hour (UBC) for battery, cryptography (RED/BLACK),* custodian, generator, operations,* mechanical, and transmission spaces:

All construction elements.......1-hour rated construction

Type II--N (UBC) for remainder of building spaces

All construction elements.......Noncombustible construction

Building Separation

Site-specific information is required. Comply with the second figure in Vol 2, SB3, Fire Protection/Life Safety.

.Interior finishes

See Guidance/Life Safety, Vol 2.

Fire protection systems

Automatic fire suppression

A water sprinkler system shall be provided throughout the entire facility.

C. A Halon 1301 or carbon dioxide system shall be provided under raised floor areas containing nonmetallic, sheathed, exposed cables when the space under the raised floor is used as an air plenum.

Automatic notification/alarm

A general alarm must be activated by the automatic sprinkler system.

D. Local alarms are required to sound only in the designated spaces; they are activated by smoke detectors.

Automatic fire detection

E. Smoke detectors are required to activate local alarms only in the designated spaces. In rooms containing raised floor areas, smoke detectors shall be located under the raised floor.

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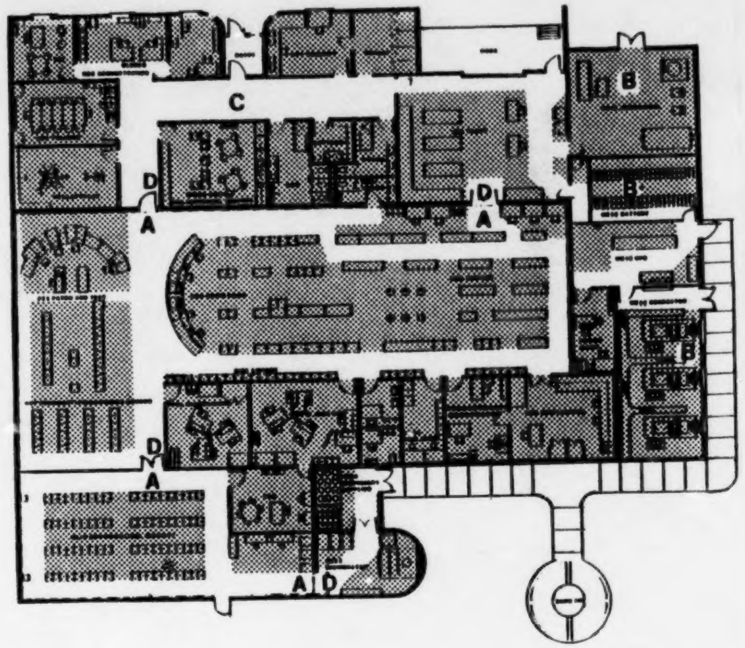
*See Vol 2, SB7, Security, for vault construction requirements that may be more stringent than those imposed by fire protection requirements.



OCCUPANT LOAD FOR DETERMINEING EXIT REQUIREMENTS.

Occupant load factor: 100 square feet per person based on gross floor area (Business Occupancy-NFPA)

Occupant load (total facility) $= \frac{18555 \text{ sq ft}}{100} = 186$ persons

Occupant load (vaulted area) $= \frac{9800 \text{ sq ft}}{100} = 98$ persons

Occupant load-(admin/support) $= \frac{4065 \text{ sq ft}}{100} = 41$ persons

Exit capacities

Corridors--100 persons per unit of exit width for travel in either direction. The minimum width of any exit access corridor or passageway shall be 44 inches in the clear.

Doors--100 persons per unit of exit width (a 3-foot door provides 1.5 units of exit width, providing an exit capacity for 150 persons).

Number of exits

No less than two exits shall be accessible from every part of every floor. One exit is permitted when the room or area has: (1) a total occupant load of less than 100 persons, (2) direct exit to an open area outside the building at the ground level, and (3) a total travel distance on the same level of not over 100 feet. (If stairs are involved, they shall be no more than 15 feet in height and shall be provided with complete enclosures to separate the stairs from any other part of the building.)

Exit travel distances

Required exits shall be located to allow access without passage through areas that may be locked. No dead end corridor shall exceed 50 feet. Travel distance to exits shall be no more than 300 feet when the building is protected throughout by an approved automatic sprinkler system.

Arrangement of means of egress

Exit access and travel routes to exits are shown in the plan.

A. Exit doors in vaulted areas that contain communications equipment are secured and permit egress out only. Exit access routes through vaulted areas from spaces outside the vaulted area are not permitted for security reasons.

B. Two means of egress shall be provided from higher hazard areas, including mechanical and generator spaces. Exit access from any other space may not pass through the mechanical or generator spaces (see exit marking). For security, when mechanical or generator spaces have exit access routes through interior spaces, exit access doors from these spaces, when opened, shall sound an alarm and transmit a signal to the annunciator panel in the security space. Access for normal maintenance in mechanical and generator spaces shall be through the exterior doors.

guidance **10. Life Safety**

Interior finishes

C. Interior finish in exit access corridors shall be Class A only.

Interior finish in the remainder of the building shall be Class A or B only.

Means of egress lighting

Exits and exit access, including stairs, aisles, corridors, and passageways leading to an exit, shall be lighted continuously during times when the conditions of occupancy require means of egress to be available. Lighting should be no less than 1 footcandle measured at the floor.

Emergency lighting

Emergency lighting shall be provided in windowless buildings for designated aisles, corridors, and passageways leading to an exit. Emergency lighting shall stay at least 1 footcandle throughout the means of egress for 1.5 hours in the event of normal lighting failure.

Marking the means of egress

Exits shall be marked by an approved sign readily visible from any direction of exit access. Signs shall be placed such that no point in the exit access is more than 100 feet from the nearest visible sign.

D. Doors located or arranged so that they are likely to be mistaken for exits shall be identified by a sign reading "NOT AN EXIT."

guidance

Message-I-S/A AMPE [AM]

The I-S/A AMPE program stems from a 1974 General Accounting Office (GAO) report which identified the need to (1) establish a single DOD manager for the terminal-to-terminal AUTODIN system, (2) consolidate separate general purpose and intelligence telecommunications centers, (3) extend telecommunication automation, and (4) introduce a standardized message processing system. In 1975, the Defense Communications Agency (DCA) provided an overall approach called the "Integrated AUTODIN System Architecture" (IASA). The IASA increases standardization of the Defense Communications System (DCS). The I-S/A AMPE Program is an element of the IASA designed to replace the Services' and Agencies' AMPEs as well as the AUTODIN Switching Centers (ASCs), extend automation to users and, through modularity and flexibility in both hardware and software, allow for graceful evolutionary growth by providing for the introduction of new features, functions, and services.

The I-S/A AMPE operational concept involves fielding approximately 90 I-S/A AMPEs worldwide. Initially, separate I-S/A AMPEs will be installed for the DSSCS and GENSER communities. Although implemented separately, these I-S/A AMPEs will be identical, except for the type of traffic being processed and the data base information contained in the system (e.g., routing doctrine, subscriber attributes). DSSCS I-S/A AMPEs will process DSSCS messages and intercommunicate with GENSER I-S/A AMPEs as required to process GENSER messages. However, GENSER I-S/A AMPEs will neither process nor have access to DSSCS messages.

The I-S/A AMPE, as the replacement for today's ASCs and AMPEs, will continue to perform the functions necessary to provide Formal Message Service to its users (e.g., message input and output, accountability and record-keeping, conversions for plain language address to routing indicator to logical address). Concurrent with providing these functions and features, the I-S/A AMPE will provide certified multilevel security at the Class A1 level and will meet performance requirements of 99.95 percent operational availability and a workload equivalency of 40 to 120 lineblocks per second.

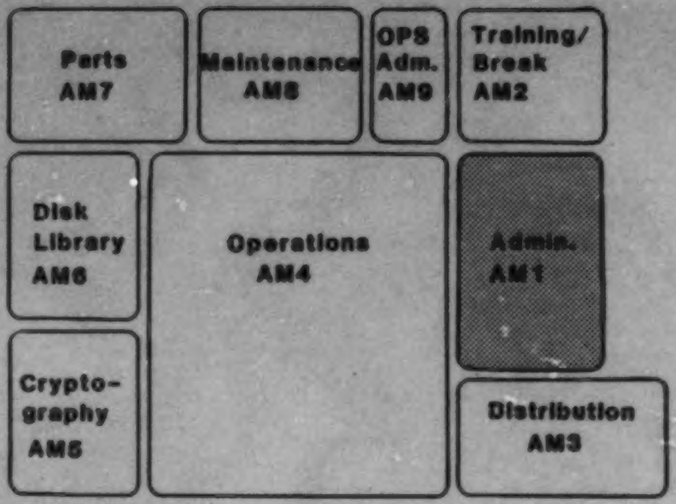
The I-S/A AMPE design includes several features which make the system "user-friendly," such as the capability to display error messages in noncommunications-oriented terminology, to generate and transmit standardized service messages without operator intervention, to quickly locate faults in the I-S/A AMPE system through the use of an automated fault detection and isolation system, and to enter and receive messages via a MEPS workstation. The MEPS workstation, a selectable option, will facilitate message entry and receipt by other than communications-oriented personnel. MEPS workstations will allow a user to create, edit, send, and receive formal messages and can be located in the I-S/A AMPE facility or remotely in an office environment, thereby further extending automation to the users.

Policy

1. The Military Departments (Services) and DOD Agencies have been directed by DOD policy to satisfy formal (16-line military message formatted) message traffic via the AUTODIN system and to transition that traffic to the Inter-Service/Agency Automated Message Exchange (I-S/A AMPE) of the Integrated AUTODIN System (IAS). By DOD direction, the I-S/A AMPE will:
    - Replace existing Service and Agency base-level AMPEs
    - Replace the AUTODIN Switching Centers' (ASCs) message functions
    - Be an A1 multilevel secure host subscriber of the Defense Data Network (DDN)
    - Be able to simultaneously process both Defense Special Security Community System (DSSCS) and General Service (GENSER) message traffic.
2. The I-S/A AMPEs will connect to the DDN via BLACKER Front End (BFE) Host to Host Protection (H2P) devices. Each I-S/A AMPE will have two connections to the DDN, one each to two DDN Interface Message Processors (IMPs); each connection is protected by a BFE. Further, when I-S/A AMPE and the IMP are not collocated, link encryption will be provided by the TSEC/KG-84A in addition to the BFE.
3. In its initial implementation, the I-S/A AMPE will be fielded in two groups, GENSER and DSSCS. GENSER I-S/A AMPEs will serve only GENSER subscribers, whereas the DSSCS I-S/A AMPEs will serve both DSSCS and DSSCS/GENSER subscribers. DSSCS/GENSER subscribers are actually DSSCS subscribers who are allowed to transmit and receive GENSER message traffic. When computer security state of the art permits, DSSCS and GENSER will be fully integrated, allowing any I-S/A AMPE to have both DSSCS and GENSER subscribers.
4. The I-S/A AMPEs will connect to the BFEs using Internet Protocol (IP) and DDN Standard X.25 protocol. The BFEs, in turn, will connect to the IMPs using DDN Standard X.25. The IP implementation will include the mandatory use of the IP Security Option (IPSO) field to convey a transport security level (hierarchical classification in combination with a nonhierarchical category.) Four categories have been identified so far: DSSCS, Single Integrated Operational Plan (SIOP), US GENSER less SIOP, and Allied GENSER.

Message-I-S/A AMPE (AM) AM-1
AM1 Administration AM-2
AM2 Training/Break Area AM-6
AM3 Distribution AM-10
AM4 Operations AM-14
AM5 Cryptography AM-20
AM6 Disk Library AM-26
AM7 Parts AM-32
AM8 Maintenance AM-36
AM9 Operations Administration AM-42
AM10 Standardized Modules AM-46

ADMINISTRATION AM1


Parts
AM7
Maintenance
AM8
OPS
Adm.
AM9
Training/
Break
AM2
Disk
Library
AM6
Operations
AM4
Admin.
AM1
Crypto-
graphy
AM5
Distribution
AM3

function

To establish and maintain administrative processing of the station's personnel records. To implement written and verbal standard operating procedure (SOP) directives from Chain of Command orders, host agency regulations, and DCA policy for DCS.

policy/sop

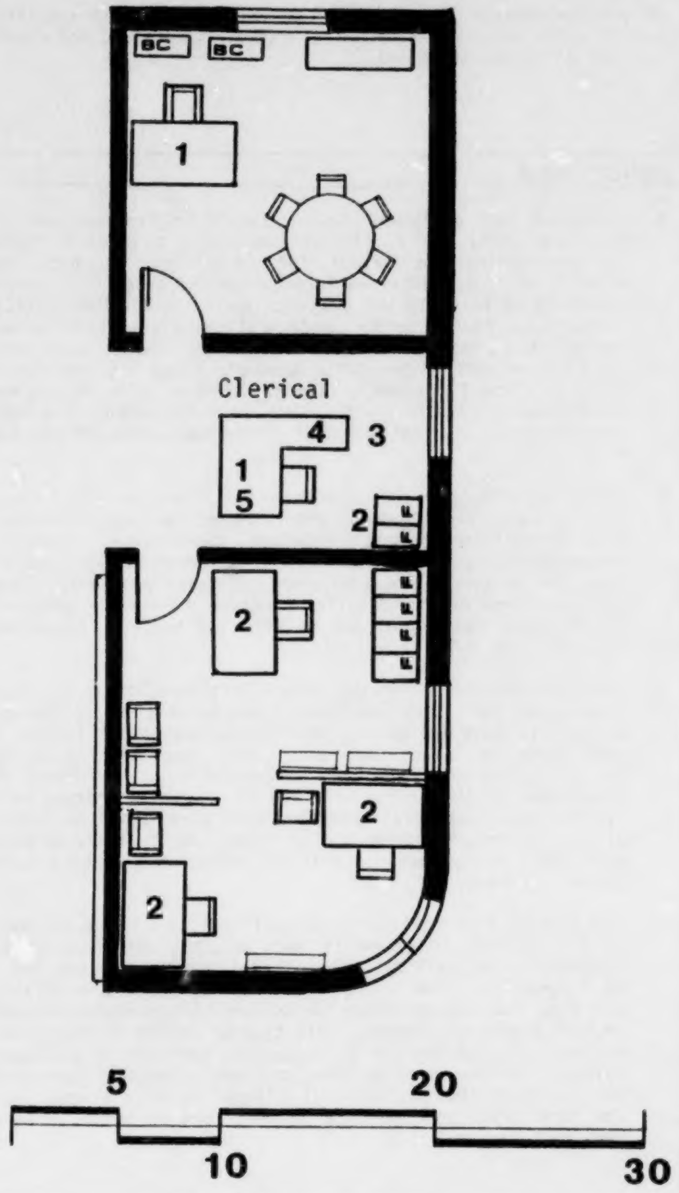
1. The traffic division officer establishes policy concerning message center operations and is responsible to the communications officer.

issues and assumptions

activities	personnel	equipment *
Officer-in-charge (OIC) 1. Distributing directives, orders, and policy statements, both written and verbal, to shift supervisors. 2. Initiating evaluation of equipment capabilities. 3. Developing personnel training plans and equipment evaluations.	1. Site chief or OIC. 2. NCOIC and chief-in-charge. 3. Two NCO's	**1.** Site chief workstation: • Desk/chair. (enclosed) • Table with six side chairs. • Credenza. • Bookshelves -- 8 linear feet. **2.** NCO workstations: • Desk/chairs. (in open area with dividers) • Four side chairs. • Five files with five drawers each. • Bookshelves -- 12 linear feet.
Clerical 1. Typing, reception, and coordination of command/control process for the noncommissioned officer in charge (NCOIC). 2. Filing/posting of operations and personnel documents. 3. Providing courier service for paperwork.	1. One E-2 clerk (two at some installations).	**1.** Clerk workstation: Desk/chair (open area). **2.** Two files with five drawers each. **3.** Bookshelves -45 linear feet. **4.** Typewriter(s)/word processor(s). **5.** Operational voice intercom control. * see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the administrative function.	**1.** Provide administrative space for supervisory personnel. This area varies with the number of assigned personnel, but is typically 700 to 800 square feet.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Carpet. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	**3.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**3.** See reference 201, page 3-4, Table 3-2.
4. Adequate lighting.	**4.** Provide 80 footcandles for task lighting at work surfaces with 40 footcandles for the ambient level. Surface reflectances should be: • Ceilings--80 to 90 percent • Walls--40 to 60 percent • Floor--20 to 40 percent.	**4.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for the occupant.	**5.** Maintain temperature at 68°F (heating), 78°F (cooling), with 5 cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	
6. Electrical power.	**6.** Provide 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppresion--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunicator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location

Windows to the outside are recommended for CONUS facilities on secure sites, such as military installations. OCONUS facilities usually should have a minimum of windows to limit opportunities for forced entry.

Activity subspaces

- Enclosed offices
- Workstations
- Filing area
- Reception.

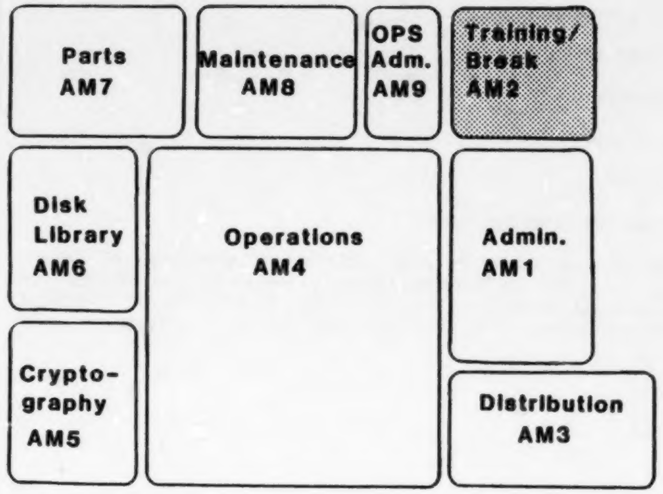
3. Acoustical and visual privacy

Divider partitions between workstations ,should be 60 inches high (± 4 inches) to provide visual privacy while occupants are seated--and yet should not be confining. Circulation paths around workstations should minimize disturbances to other workstations.

6. Electrical power

Workstation divider partitions can be tackboard surfaces to display maps, job examples, service equipment, and other information. Floor-to-ceiling poles are recommended to distribute electrical and communication lines to workstation modules. This eliminates floor wires at circulation paths and allows future module modifications at minimal cost.

TRAINING /BREAK AREA AM2



function

To provide message processing and manual tape relay to specified units and to allow personnel to operate, maintain, monitor, and repair communication equipment optimally.

policy/sop

1. Equipment and equipment layout should be standardized as much as possible among the facilities comprising a communications system. In determining the layout for facilities in which unencrypted signals bearing classified information are present or processed, the specialized installation guidance found in MIL-HDBK-232(C) must be consulted. Another major consideration is the access necessary for installation, maintenance, and operation. This would include considerations such as providing adequate space between rows of equipment to allow for opening cabinet doors or sliding out modules for maintenance. Another major, but less important, consideration is providing the shortest and most direct waveguide run practical. (2) 5-20

2. Other equipment layout considerations include minimizing interbay cabling runs, providing for future expansion, and providing easy access for maintenance and operational convenience. Sometimes the EM incompatibility of various types of equipment or inadequate ventilation for personnel and equipment can cause problems. Equipment of the same type or with similar function is usually grouped together except when impractical due to size and specific requirements of a station. (2) 5-20

3. Equipment should be grouped properly according to its function and interoperation. Care and thought should be given to the arrangement of meters, test equipment, jackfields, indicating lights, and other such items to insure they are placed approximately at eye level, thus allowing more rapid and convenient use. Equipment should not be mounted at the bottom of a bay if it can be damaged easily or if its size and shape will interfere with power boxes or other hardware at the bottom of the cabinet or rack. Most microwave radio equipment comes fully packaged with all components already mounted in a cabinet or rack. (2) 5-21

4. The station's operational plan must be studied to determine communication circuit requirements when placing each component or rack assembly. In small stations, it is recommended that the equipment be aligned in a row along, one or, if need be, both sides of the building with enough space in between to accommodate a normal floor traffic pattern. However, this type of layout generally will not be suitable in stations for which large quantities of equipment are involved. In the large station, the most practical layout is usually one in which the equipment is aligned in bays across the width of the room, with enough space between bays to permit free access to each rack assembly. (2) 5-22

5. The station must be set up for 24-hour, four-shift-per-day operation.

issues and assumptions

1. Three-shift versus four-shift impact on training time available

Most facilities operate on a three-shift basis:

• Day shift	8 a.m. to 4 p.m.
• Swing shift	4 p.m. to 12 a.m.
• Midshift	12 a.m. to 8 a.m.

By having personnel assigned to four shifts instead of three, one group could be a "training shift" that would be on duty during the day shift; thus, the peak activity period would have double the personnel available if required, plus give trainees the best opportunity to interact with facility functions.

The four-shift concept, however, assumes one or both of the following:

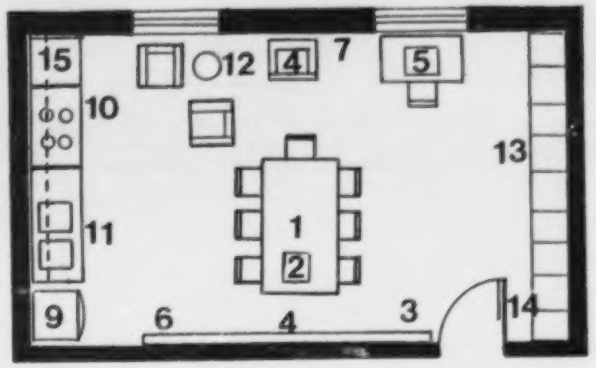
- More persons will be assigned to the site
- Staffing for the three operating shifts can be reduced.

activities	personnel	equipment *
Technical training 1. Observing and evaluating personnel records; conducting personnel interviews to determine training requirements. 2. Developing overall master training plan and presenting special MOS training module program for a specific focus. 3. Studying manuals and other publications. 4. Watching video cassettes, 16-millimeter movies, and slides. 5. Instructing in fire/life/mission safety.	Instructors 1. Commander. 2. NCOIC. 3. Civilian technicians (not an office area for personnel).	Classroom/Conference: 1. Table and seating for 4-8. 2. View graph projection. 3. Charts & display panels. 4. A/V projection & screens. 5. TEC library monitors. 6. Chalkboard. 7. Tackboard for training and information bulletins. 8. Intercom speaker.
Break Area: 1. Relaxing 2. Reading 3. Eating 4. Food storage 5. Food preparation 6. Storage of personnel items, i.e. coats, books.		9. Refrigerator 10. Range and range hood 11. 20 x 30 in. sink within counter top cabinets above. 12. Trash recepticles 13. Personnel storage lockers for each. (Not required for personnel compliment with private offices). 14. Coat rack 15. Microwave oven

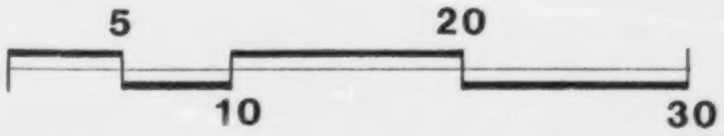
* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Adequate space to accommodate the equipment and furniture that is associated with the Personnel support/Break area.	**1.** Approximately 500 sq. ft. to provide space for equipment and furniture for up to 15 personnel.	
2. Visual separation from the communications equipment.	**2.** Visual separation that also allows for viewing of the operations area when desired. Comfortable furniture and carpet (earth tones recommended).	
3. Interior finishes: Finishes suitable for durability, maintenance, and room function.	**3.** Floor - Vinyl asbestos tile and area carpet. Base - Glazed structural units, rubber, vinyl or comparable resilient material. Walls - Paint over concrete, gypsum board, or plaster. Ceiling - Acoustic tile.	**3.** See also Vol.IC - "Site and Building Information" SB2, Interior Construction and Finishes.
4. Acoustical isolation/attenuation: Acoustical comfort for a non-disruptive environment.	**4.** The walls around the room should limit sound transmission to 40 db. Ceiling material should be rated at NRC .50 (min.), floor surface at NRC .25 (min.), and divider partitions (if used) at .85.	**4.** See reference 201, page 3-4, Table 3-2.
5. Adequate lighting for reading (task) & (ambient).	**5.** Adjustable lighting depending on varied uses. .20-80 fc @ Work surfaces. .10 fc at rear of room during AV projection Surface Reflectances: ceiling: 80 - 90% walls: 40 - 60% floor: 20 - 40%	**5.** For further information on quality of lighting design using the ESI concept, see SB2- Electrical, lighting.
6. Comfort: Thermal.	**6.** 68°F (heating); 78°F (cooling) 5 CFM/person outside air ventilation rate.	**6.** See also SB2- Communication Station Buildings - Mechanical.
7. Electrical Power.	**7.** 120/208 electrical service. 120 volt outlets; one receptacle for every 10 linear feet of wall. Counter height outlets for: coffee maker mixer microwave (where permitted)	**7.** See also SB2- Communication Station Buildings - Electrical.
8. Fire Protection/Life Safety. Criteria are based on the assumption this facility is windowless and in addition houses critical equipment and data which creates a severe strategic fire loss potential.	**8.** Interior finish: Class A or Class B only Corridor finish: Class A only Automatic fire suppression: Water sprinklers Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunicator panel and local fire department or constantly manned station outside the facility.	**8.** See Standardized Modules - Building Design Principles and SB3- Fire Protection/Life Safety for more information.

guidance



8-- speaker in ceiling



guidance

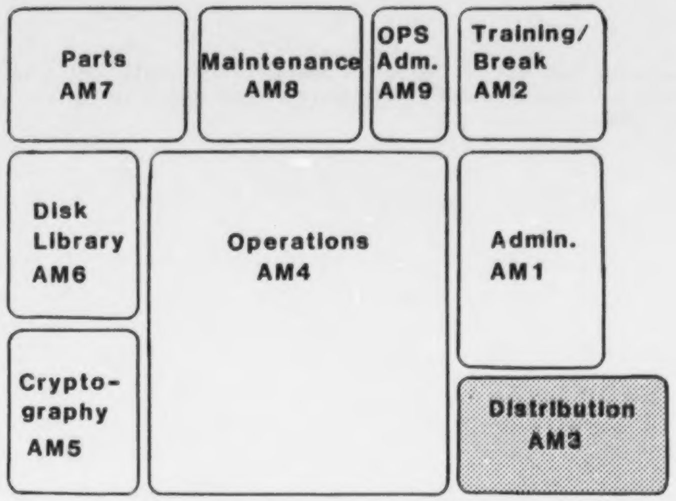
1. Location:

The personnel support space should be directly adjacent to operations room, but isolated acoustically and visually (a curtain at the window).

3. Visual Comfort:

The color contrast, textures and designs of the wall, ceiling, and floor surfaces should minimize glare and enhance a comfortable environment.

DISTRIBUTION AM3


Parts
AM7
Maintenance
AM8
OPS
Adm.
AM9
Training/
Break
AM2
Disk
Library
AM6
Operations
AM4
Admin.
AM1
Crypto-
graphy
AM5
Distribution
AM3

function

To provide an area for Base Communications customers to deliver messages for outbound processing plus an over-the-counter message pickup service.

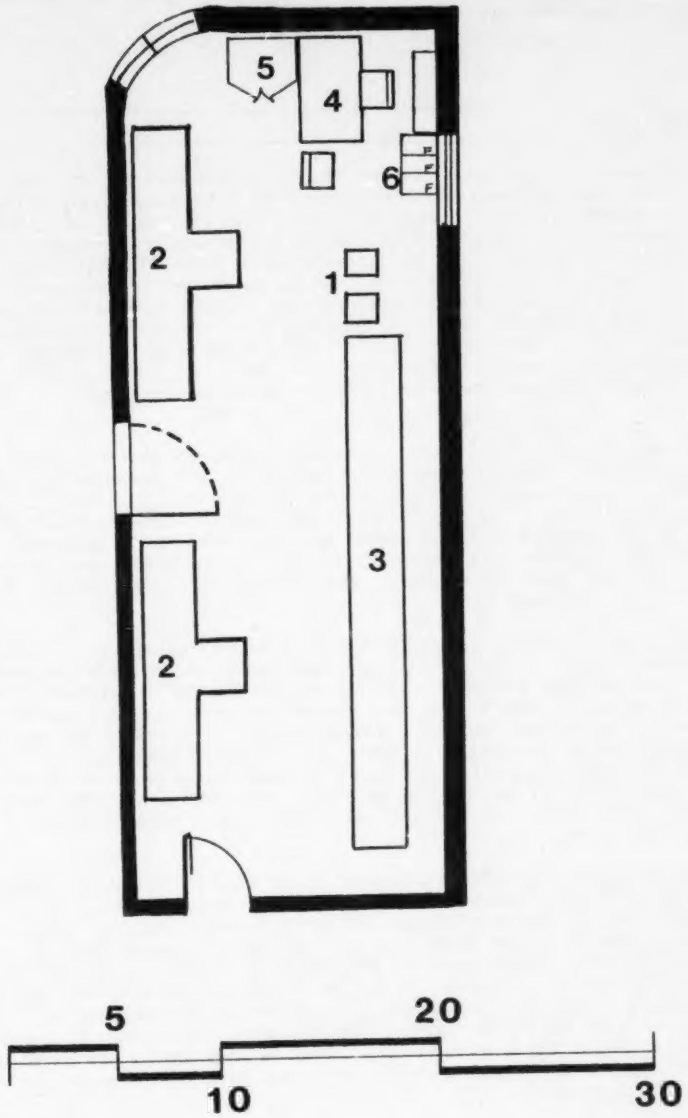
policy/sop

1. Operates as the pick-up point for the 24-hour-a-day distribution of communication messages to local customers. Handles all written communication forms--both transmission and receiving.

issues and assumptions	**activities**	**personnel**	**equipment** *
	1. Reproducing and distributing message traffic or information of vital concern.	1. Distribution clerk 2. Xerox operator (Depending on size of operation.)	**1.** Xerox copier. **2.** Distribution boxes. **3.** Message pick-up and authorization counter. **4.** Desk with chair. **5.** Supply cabinets. **6.** Three files. * see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate distribution boxes or an automated message distribution system (MRDIS) if applicable.	**1.** Varies due to extent of equipment required for the traffic volume. Approximately 600 square feet for the pick-up entry and the message distribution room.	
2. Security window.	**2.** Barred window with plexiglass separation or shatterproof glass with communication system between user and clerk.	
3. Storage.	**3.** Burn bag storage area.	
4. Interior finishes suitable for durability, maintenance, and room function.	**4.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	
5. Acoustical isolation/attenuation for a nondisruptive environment.	**5.** Walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .90.	
6. Adequate lighting.	**6.** Provide 80 footcandles for task lighting at work surface, with 40 footcandles for the ambient level. Surface reflectances should be: Ceilings--80 to 90 percent. Walls--40 to 60 percent. Floor--20 to 40 percent.	
7. Comfort: Thermal.	**7.** Temperature should be maintainable at 68°F (heating), 78°F (cooling) with a 5 cubic feet per minute per person outside air ventilation rate.	
Occupant.	Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	
8. Electrical power.	**8.** Install 120/208 electrical service. The 120-volt a.c. receptacles should be located at all workstations and workbenches at a convenient height and/or for every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	
9. Fire protection/life safety.	**9.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**9.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance


5
4
6
2
1
3
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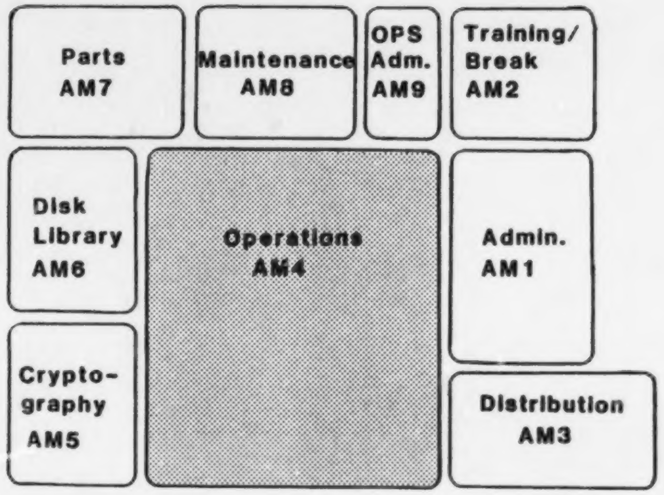
10
30

guidance

OPERATIONS AM4



function

To provide message processing and manual tape relay to specified units and to allow personnel to operate, maintain, monitor, and repair communication equipment optimally.

policy/sop

1. Equipment and equipment layout should be standardized as much as possible among the facilities comprising a communications system. In determining the layout for facilities in which unencrypted signals bearing classified information are present or processed, the specialized installation guidance found in MIL-HDBK-232(C) must be consulted. Another major consideration is the access necessary for installation, maintenance, and operation. This would include considerations such as providing adequate space between rows of equipment to allow for opening cabinet doors or sliding out modules for maintenance. Another major, but less important, consideration is providing the shortest and most direct waveguide run practical. (2) 5-20

2. Other equipment layout considerations include minimizing interbay cabling runs, providing for future expansion, and providing easy access for maintenance and operational convenience. Sometimes the EM incompatibility of various types of equipment or inadequate ventilation for personnel and equipment can cause problems. Equipment of the same type or with similar function is usually grouped together except when impractical due to size and specific requirements of a station. (2) 5-20

3. Equipment should be grouped properly according to its function and interoperation. Care and thought should be given to the arrangement of meters, test equipment, jackfields, indicating lights, and other such items to insure they are placed approximately at eye level, thus allowing more rapid and convenient use. Equipment should not be mounted at the bottom of a bay if it can be damaged easily or if its size and shape will interfere with power boxes or other hardware at the bottom of the cabinet or rack. Most microwave radio equipment comes fully packaged with all components already mounted in a cabinet or rack. (2) 5-21

4. The station's operational plan must be studied to determine communication circuit requirements when placing each component or rack assembly. In small stations, it is recommended that the equipment be aligned in a row along, one or, if need be, both sides of the building with enough space in between to accommodate a normal floor traffic pattern. However, this type of layout generally will not be suitable in stations for which large quantities of equipment are involved. In the large station, the most practical layout is usually one in which the equipment is aligned in bays across the width of the room, with enough space between bays to permit free access to each rack assembly. (2) 5-22

5. The station must be set up for 24-hour, four-shift-per-day operation.

issues and assumptions

1. Automated recordkeeping

Cathode ray tubes (CRTs) with hardware printers can streamline paper work by having all circuit history files on disk, thereby eliminating time-consuming paperwork. This will allow trouble shooting activities to be much more rapidly accomplished in-house.

2. I/C process

The Communications Installation Implementation/Conversion (I/C) process for the I-S/A AMPE equipment involves the following steps:

a. Preparing the facility for the new hardware.

b. Installing new automatic data processing equipment (ADPE) while continuing support and operations of the existing ADPE.

c. Developing operational capability of new ADPE while operating existing ADPE.

I/C requires concurrent operations of existing and new ADPE for up to 90 days. Bases altering or adding to existing facilities must consider this when estimating construction costs and phasing. (Space and construction requirements in this guide are based on the project and position and not on transition requirements.)

3. DSSCS versus GENSER message distribution

Y-type messages (Defense Special Security Communication System, DSSCS) require a secure area for processing. Thus, the receiving clerk who processes Y traffic must do so in the secure operations room rather than taking it into a nonsecure distribution room. R-type messages (General Service, GENSER) are distributed from the nonsecure area.

4. Determining the correct shielding procedure

A comprehensive approach to the shielding of equipment from radiofrequency interference (RFI) or TEMPEST involves (a) a building layout to optimize inherent facility shielding conditions, (b) suitable location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components.

See Vol 2, SB4, for additional guidance information.

5. Electromagnetic compatibility (2) 5-43

Electromagentic compatibility (EMC) is a complex subject, so that specialists often must perform the type of EMC study needed to insure the equipment or equipment layout produces no interferences or radiation hazard.

activities

1. Monitoring communication equipment (patch and test).
2. Isolating fault.
3. Doing quality control maintenance tests.

personnel

1. Two operations technicians.

equipment *

1. Electronic communication system.

2. Control console.

3. Patch bays.

4. Workbench (6 linear feet) with shelving for manuals.

5. Desk with chair.

6. CRT at console.

7. Telephones.

8. Typewriter(s) or word processor(s).

9. Filesafe.

10. Electrical shock first-aid-kit.

11. Alarm panel.

12. Operational voice intercom control.

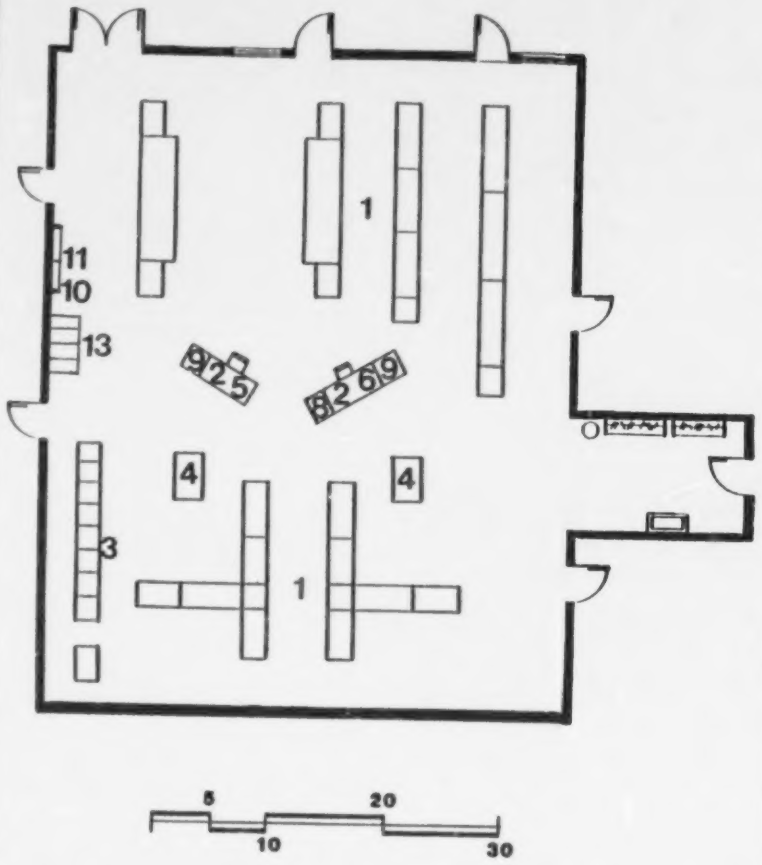
13. Record file (10 drawers).

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Adequate space for the operation and monitoring of communications-electronics (C-E) equipment. Spatial requirements must allow for proper spacing between equipment to facilitate easy maintenance.	**1.** Varies due to extent of communication equipment designed. See layout in Guidance.	
2. A secure environment for C-E equipment.	**2.** The operations room must be lockable when unstaffed and must be supplied with an intrusion alarm system. The operations console should be fitted with alarms for intrusion, power failure, and generator status. Covers should be provided on overhead rods for rapid sanitizing of applicable equipment.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Signal shielding.	**3.** See Vol 2, SB4--Grounding, Bonding and Shielding along with SB7--Security Systems for more information.	
4. EMP/HEMP shielding.	**4.** Shielding is necessary for survivability and uninterrupted functioning when the facility is subjected to EM pulse (EMP) and high-altitude EM pulse (HEMP). Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	**4.** See Vol 2, SB5, EMP/HEMP Protection, for more information.
5. Raised floor system.	**5.** Raised or false floors are necessary for proper cooling of the equipment.	**5.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
6. Interior finishes suitable for durability, maintenance, and room function.	**6.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor with a dust-on finish that contains a hardener. See Vol 2, SB2--Interior Construction. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Wall--Paint over concrete, gypsum board, or plaster and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	**6.** See also Vol 2, SB2, Interior Construction and Finishes.
7. Acoustical isolation attenuation for variable noise levels produced by electronic equipment.	**7.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile is also required to within 4 feet of the floor.	
8. Adequate lighting.	**8.** Lighting shall be specially engineered. Low levels of lighting may be required to permit observation of luminous panels without reflected glare or undesirable contrasts in brightness. Separately controlled luminaires shall be provided for normally lighted operations and for cleaning, with an ambient level of 70 footcandles from fluorescent fixtures.	**8.** For further information on quality lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.

requirements	criteria	commentary
9. Controlled environment for proper operation.	**9.** Maintain 70°F ($\pm 2^{\circ}$) and 50 percent relative humidity (± 5 percent continuously. Provide 5 cubic feet per minute per person outside air ventilation rate or the outside air quantity necessary to maintain a room pressurization requirement of .05 to .10 water gage.	**9.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
10. Electrical power.	**10.** Provide 120/128 electrical service and 120-volt outlets--one receptacle for every 10 linear feet of wall. Outlets for equipment should be available under the raised floor as per layout. Electrical power must fall within the 10,000 to 500,000 watt range, with frequency levels at 50 to 60 hertz ± 5 percent.	**10.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**11.** Vaulted enclosure walls--2 hour (minimum) fire-rated, shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area--Automatic fire detection: Local alarm. Automatic Halon 1301 suppression system if required for cross-zoned or matrix detection. Sprinkler and Halon systems are not normally installed in the same areas.	**11.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Equipment expansion

It is advisable to arrange equipment in the equipment room such that future expansion of the building will not necessitate complete rearrangement. (2) 5-21

Approximately 3 feet of clearance space, as a minimum, should be allowed in front of and to the rear of an equipment bay. If a bay does not permit rear access to equipment, the bay can be installed with no clearance on the back side, that is, against a wall or back-to-back with other bays, unless ventilation requirements are compromised. (2) 5-21

5. Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on raised floors for maximal use of coupled air directly through the cabinets. Cooling air at 60°F supplied directly into the base of the transmitters will leave the top at approximately 72°F. Thus, when the air exits the equipment, it is at a more comfortable temperature for persons working in the space.

8. Control area

Light fixtures should provide an approximate uniform lighting intensity of 70 footcandles and should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. Lights over the area in which the control console is located shall be provided with wide-range (100:1) dimming control. (23)12

Equipment area

Fixtures should be arranged above the operating aisles and should run parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so light is not obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23)12 Portable task lighting should also be supplied for the equipment area at 70 to 100 footcandles.

9. Protection from moisture migration

Operating spaces that contain electronic equipment usually require close temperature and humidity control. Vapor barriers placed under floor slabs and roofing usually prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided if exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

guidance

Mechanical

The recommended operating temperatures and humidity conditions should be obtained from the manufacturers of the communications and data processing equipment and should be used in designing the environmental control system.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Inadequate cooling contributes as much to failure as poorly regulated power. (74) 4-17

Even though certain individual units can operate outside the limits of the overall specifications, overall environmental requirements are dictated by the most restrictive unit of the system. The computer system's requirements are the major considerations; however, good design will also consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in the following ways. (74) 4-17

- Heat dissipation by computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The number of air changes per hour varies between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Also, if the air-conditioning requirements are not met, a record must be available to indicate the extent and duration of the undesirable condition and indicate whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-25

guidance

- Insure the air-conditioning system continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is needed when humidity limitations are exceeded. Drying out may be necessary if the excess humidity occurs either during periods of actual operation or while the machine is shut down and unattended. The extent and duration of excessive humidity determines the length of the drying-out period.
- Determine if the environment meets requirements for the machine.

A visual or audible signaling device is desirable in the recording instrument. This is to provide visual or audible indication that temperature or humidity in the computer area is nearing the maximum limit.

Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The recorder is usually located at a representative spot in the room and adjacent to the control devices.

For monitoring underfloor air conditions, a remote indicating instrument is recommended. This is usually a 7-day electric-drive chart and can be the wet-and-dry-bulb or electronic type if direct reading is not available. The recording instrument can be located on the wall in the operations room, in the mechanical equipment room, or in any other location convenient to the building engineer.

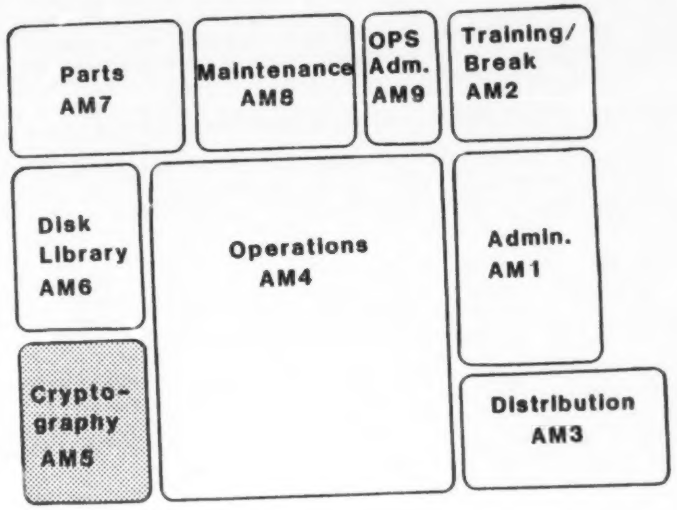
10. Electrical

Consider providing a flexible system that will meet the facility's future requirements. Electronic equipment is constantly being upgraded, modified, and replaced. Bus duct systems and cable trays may prove to be most flexible for areas in which new equipment is expected or that may have frequent modification. (5) 3-4-8

Specifically refer to the "Electrical" portion of "Issues and Assumptions" portion of SB2, Vol. 2, for information relative to host nation power requirements. Additional information may be found in "guidance" of SB2 with respect to the standard frequencies and voltage levels used by various nations.

Provide host nation standard outlets if applicable.

CRYPTOGRAPHY AM5


Parts
AM7
Maintenance
AM8
OPS
Adm.
AM9
Training/
Break
AM2
Disk
Library
AM6
Operations
AM4
Admin.
AM1
Crypto-
graphy
AM5
Distribution
AM3

function

The cryptography area provides a secure place for encryption or decryption of information that passes through the communication facility.

policy/sop

1. The national policy objective is to insure that national security information is not lost through unintentional emanations. To achieve this, equipment should be designed to meet TEMPEST requirements and should be tested to verify compliance with TEMPEST specifications. See Vol 2, SB4, for additional guidance information.

2. The RED/BLACK concept is the basis for the facility criteria development presented here. The RED/BLACK concept dictates that electrical and electronic circuits, components, equipment, systems, and other items that handle national security plain language information in electrical signal form (RED) be separated from those handling encrypted or unclassified information (BLACK). Under this concept, RED and BLACK terminology is used to clarify specific criteria relating to the difference between such circuits, components, equipment, and systems, and the area in which they are contained.

issues and assumptions

1. Proper location for cryptographic equipment

Locate sensitive and critical equipment as close to the core of the structure as operational requirements permit. In addition, identify the location of likely sources of interference such as power substations, engine-generators, and RF transmitters; maximize the separation between such sources and potentially susceptible equipment or systems. (15b) 1-173

2. Electromagnetic compatibility (2) 5-43

Electromagnetic compatibility (EMC) is a complex subject, so that specialists often are needed to perform the type of EMC study needed to insure that the equipment or equipment layout produces no interference or radiation hazard.

DOD is working on new regulations to control permissible levels of EM pollution of the frequency spectrum. This work reflects the concern for environmental protection. Radiation hazards also are being regulated through concern for occupational safety. Engineering agencies working for the military must therefore know the legal and regulatory aspects of the EMC and radiation hazards to meet these requirements.

Military specifications on EMC such as MIL-STD-461, -462, and -463 are intended to control and achieve an acceptable figure of merit or quality in the development of new communications equipment. They do not eliminate the need for EMC engineering in facility design. In addition to equipment quality, the frequency selection, nearness to other facilities, and, to some extent, the facility design itself are variables in the interference generation problem. (2) 5-43

3. Correct shielding procedure

A comprehensive approach to shielding equipment from radiofrequency interference (RFI) or TEMPEST involves (a) a building layout to optimize inherent facility shielding conditions, (b) suitable location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components. See Vol 2, SB4, for additional guidance information.

activities

1. Encrypting and decrypting information.
2. Maintaining the CRYPTO equipment.
3. Taking responsibility for the use and security of COMSEC cards.

personnel

1. Two technicians.

equipment

1. CRYPTO equipment racks.
2. Multiplex racks.
3. Clock/timing.
4. Workbench (36 by 72 inches).
5. Two cabinets for parts (24 by 40 inches).
6. Test equipment on carts (two at 30 by 40 inches).
7. Mobile teletype (24 by 36 inches).
8. Eight linear feet of bookcase.
9. Safety gear board (wall-mounted).
10. Shredder for COMSEC cards (30 by 36 inches).
11. Intercom speaker.

* see "guidance" box for example layout of all equipment

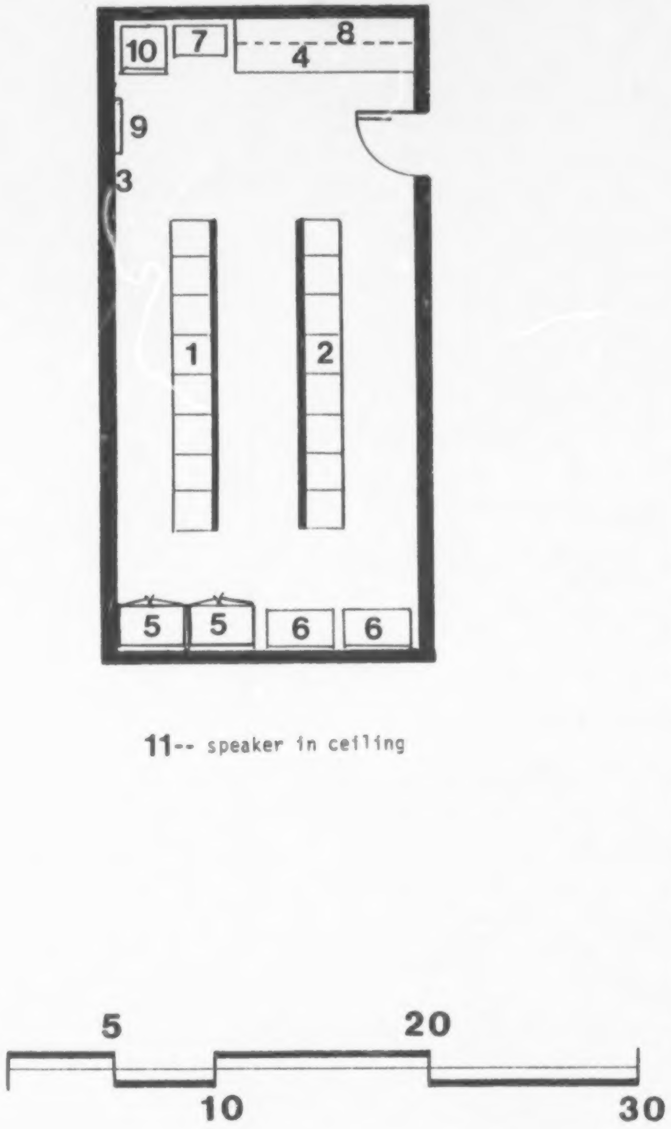
of all equipment

listed.

requirements	criteria	commentary
1. Enough space to accommodate two or three persons exercising, plus space to move about for shelving items.	**1.** Allow approximately 250 square feet to accommodate the exercise equipment plus 60 linear feet of shelf space.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	**3.** Adjacent room walls should limit sound transmission to 40 decibels.	
4. Adequate lighting.	**4.** Use 30-footcandle (ambient) fluorescent fixtures.	
5. Thermal comfort.	**5.** Regulate temperature at 68°F (heating), 78°F (cooling). Provide 10 cubic feet per minute per person outside air ventilation rate with on-off switching.	**5.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
6. Electrical power.	**6.** Install 120/208 electrical service. Provide 120-volt outlets--one receptacle for every 10 linear feet of wall. Frequency levels should be at 50 to 60 hertz ± 5 percent.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

requirements	criteria	commentary
8. Adequate lighting.	**8.** Light fixtures should provide an approximate uniform light intensity of 70 footcandles and should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. Fixtures shall also be equipped with integral RF interference filters (GE no. 89G635, Sprague IF-37, or equivalent). The work area shall also be equipped with adjustable task lighting.	
9. Thermal comfort.	**9.** Temperature should be kept at 68°F (heating) and 78°F (cooling). A 5-cubic feet per minute per person outside air ventilation rate should be maintained.	**9.** See also Vol 2, SB2, Communication Station Buildings--Mechanical
10. Electrical power.	**10.** Power should be supplied by a 120/208 electrical service. A 120-volt receptacle should be installed for each workstation at a convenient height and/or for every 10 linear feet of wall. Electrical power must fall within the 10,000- to 500,000-watt range. Frequency levels must be at 50 to 60 hertz ± 5 percent. Provide line filters for RFI on all electrical power lines.	**10.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumption that this facility houses critical equipment and data, which creates a severe strategic fire loss potential.	**11.** Vaulted enclosure walls--2-hour minimum fire-rated construction; shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or to constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area automatic fire detection--Local alarm; automatic Halon 1301 suppression system if cross-zoned or matrix detection is required. Sprinkler and Halon systems are not normally installed in the same areas.	**11.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



11-- speaker in ceiling

guidance

9. Protection from moisture migration

Operating spaces that contain electronic equipment usually require careful temperature and humidity control. Vapor barriers under floor slabs and incorporated into roofing usually are able to prevent moisture migration into and out of the interior electronic equipment spaces. Additional protection must be provided if exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Inadequate cooling contributes as much to failure as does inadequately regulated power. (74) 4-17

Even though certain individual units may be operated outside the limits of the overall specifications, the system's environmental requirements are dictated by the most restrictive unit of the system. Computer system requirements are the major considerations in designing the air-conditioning system. However, good design will also consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in that: (74) 4-17

- Heat dissipation by the computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity, because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- Air changes per hour number between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain necessary humidity conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor will damage the electronic equipment. (40) 7-3

guidance

An air-conditioning system for a computer installation differs from ordinary comfort air conditioning as follow: (74) 4-17

- Heat dissipation by the computers is relatively constant; therefore, cooling is required on year-round basis.
- The computer room sensible heat ratio is near unity, because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- Number of air changes per hour varies between 30 and 60 because of the high heat dissipation of the computer equipment.
- Humidity control is required year round to maintain necessary humidity conditions in the computer room.

However, the introduction of water vapor into the air stream for humidification purposes is not recommended for electronic equipment areas, because the water vapor is detrimental to the electronic equipment. (40) 7-3

10. Temperature and humidity recording instruments:

Recording instruments are necessary to provide a continuous record of temperature and humidity conditions in the machine area. Also, if the air conditioning requirements are not met, a record is available to indicate the extent and duration of the undesirable condition and indicate whether a drying-out period is required. This may, in some cases, save machine shut-down time. (74) 4-25

The record of temperature and humidity can be used: (74) 4-25

- To assure that the air conditioning installation is continuously performing its job properly. Installation errors and loss of efficiency due to malfunction of some part of the air-conditioning system can be quickly detected.
- To determine if a mandatory drying-out period is necessary when humidity limitations are exceeded. The drying-out may be necessary if the excess humidity occurs either during periods of actual humidity operation or during periods when the machine is shut down and unattended. The extent and duration of the excess humidity is used to determine the duration of the drying-out period.
- To determine if the environment in the area meets the requirements for the machine.

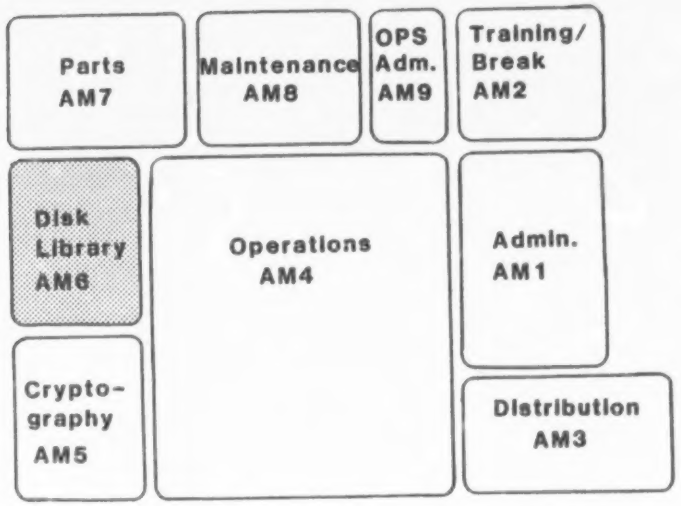
guidance

A visual or audible signal device is desirable in the instrument. Its purpose is to provide a visual or audible indication that the temperature or humidity conditions in the computer area are nearing the maximum limitations.

Direct-reading instruments with a 7-day electric-drive chart is sometimes used in installations to monitor the ambient room conditions. The recorder is usually located at a representative location within the room and adjacent to the control devices.

For use in monitoring the underfloor air conditions, a remote indicating instrument is recommended. This is usually a 7-day electric-drive chart and can be the wet and dry bulb or electronic type if direct reading is not available. The recording instrument can be located on the wall in the room or in the mechanical equipment room or any other location convenient to the building engineer.

DISK LIBRARY AM6


Parts
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Maintenance
AM8
OPS
Adm.
AM9
Training/
Break
AM2
Disk
Library
AM6
Operations
AM4
Admin.
AM1
Crypto-
graphy
AM5
Distribution
AM3

function

To provide a secure storage area for movable head disks and magnetic tapes. This area serves as a software library.

policy/sop

1. Current policy is to have a separate, secure storage space that maintains constant temperature and humidity.

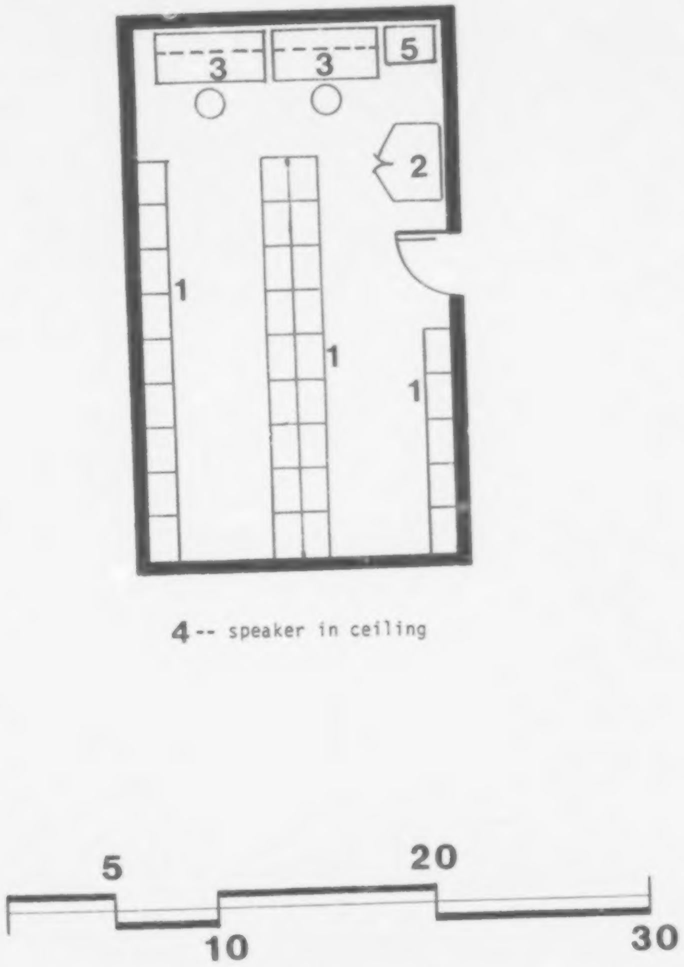
issues and assumptions	activities	personnel	equipment *
	1. Storing disks. 2. Retrieving disks.	1. One or two as required.	**1.** Thirty linear feet of cabinets with shelves for disks. **2.** One file cabinet (five-drawer) for records. **3.** Two 30 by 60 inch workbenches with stools for maintenance activities. **4.** Intercom speaker. **5.** Tape cart.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for inspection, disassembly, and reassembly of sensitive electronic equipment. Space must also accommodate administrative, tool, and part needs.	**1.** Provide approximately 500 square feet.	
2. A secure, controlled area.	**2.** The room should be lockable when unstaffed.	**2.** See Vol 2, SB7, Security (Zone 3) for more information
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**3.** See also Vol 2, SB2, Interior Construction and Finishes
4. Acoustical isolation and attenuation to eliminate C-E equipment noise to help personnel concentrate when they work on electronic components.	**4.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC. 90, floor surface at NRC .50, and divider partitions (if used) at .85.	
5. Adequate lighting.	**5.** Fixtures should provide 70 footcandles for ambient lighting and 150 footcandles for task lighting.	**5.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical Lighting.
6. Thermal regulation and other comfort features for occupants.	**6.** Regulate temperature at 68°F (heating), 78°F (cooling), with a 5-cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adustment, casters, swivel, and independent backrest adjustment.	
7. Electrical power.	**7.** Install 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height for every 10 linear feet of wall. Provide four duplex outlets at each workbench. All equipment and workbenches must be grounded. Frequency levels should be 50 to 60 hertz ± 5 percent.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**8.** Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

requirements	criteria	commentary
9. Fire protection/life safety criteria are based on the assumption that this faciilty is windowless and houses critical equipment and data that have a severe fire loss potential.	**9.** Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**9.** See Vol 2, Standardized Modules--Building Design Principles, and SB3, Fire Protection/Life Safety, for more information.

guidance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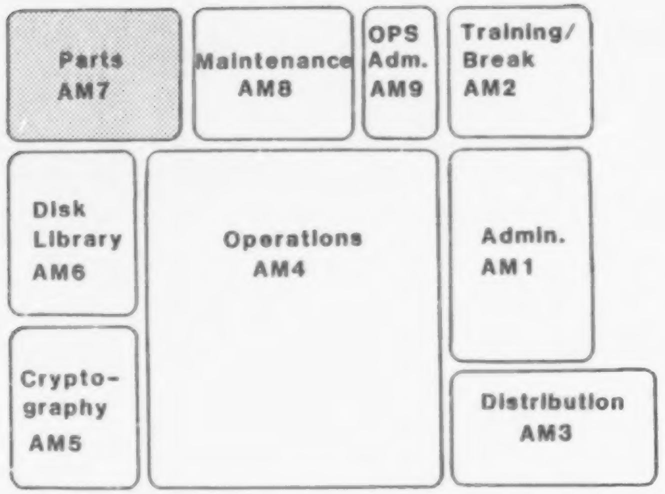
4 -- speaker in ceiling

guidance

guidance

guidance

PARTS AM 7


Parts
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AM9
Training/
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AM2
Disk
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AM6
Operations
AM4
Admin.
AM1
Crypto-
graphy
AM5
Distribution
AM3

function

To provide area for the temporary placement of miscellaneous items and nontechnical equipment and for managing all parts supply operations: ordering, receiving, storage, inventory, and security.

policy/sop

1. Requirements for spare parts storage space are determined by the type of equipment at the installation and the level of maintenance to be performed onsite.

2. During preventive maintenance inspections, it may be noticed that some components' performance has deteriorated. Rather than wait for the component to become weaker or to fail completely and cause system interruption, it is considered good maintenance practice to replace the faulty parts during the inspection. Although components would be replaced before their full service life has been realized, service interruptions could be avoided. This practice would, in turn, increase the expected replacement parts cost for an operating system; however, the increase would be justified on the basis of increased system reliability and savings for additional manpower costs that would be incurred in making special trips to unattended stations to restore system operation. (70) 7-49

issues and assumptions

activities

1. Inspecting and diagnosing equipment and parts.
2. Completing preventive and unscheduled maintenance.
3. Assembling electronics.
4. Testing electronics.
5. Securing storage of parts and equipment.
6. Maintaining records on parts and equipment.
7. Writing and typing reports, PMI 349's, and equipment historical records.

personnel

1. Shift supervisor.
2. One or two specialists.

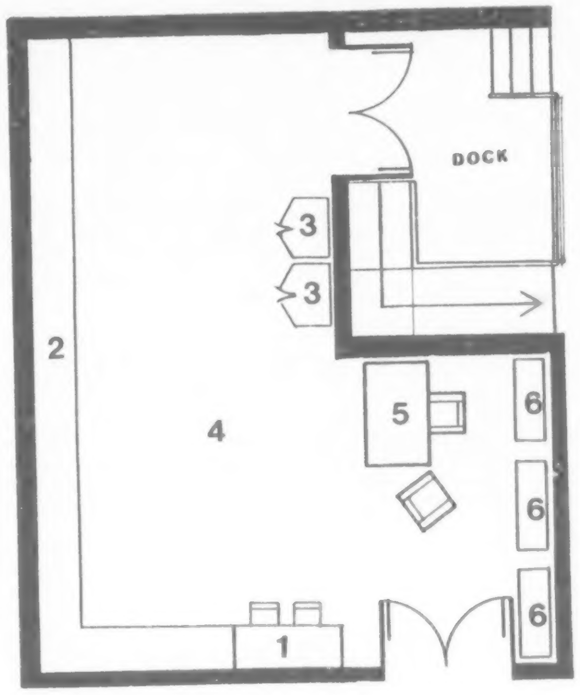
equipment *

1. 30" x 60" table w/chair.
2. Shelving - 30 ln. ft. of floor-to-ceiling shelving.
3. 3 locked cabinets (24" x 36").
4. 100 sq. ft. open area for unpacking orders.
5. Desk with chair for parts ordering, microfiche unit.
6. Bookcase for supply manuals - 3 to 4 ln. ft.
7. Intercom speaker.

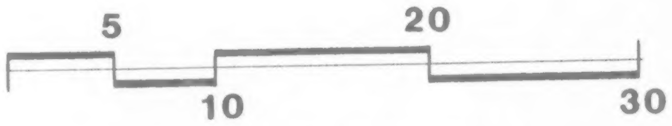
* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for ordering, receiving, and storing C-E equipment. Space must include an open area to facilitate easy receiving of large equipment and supply orders.	**1.** Provide approximately 1000 square feet to accommodate storage shelves and to leave an open area for receiving shipments of parts and supplies.	
2. A secure environment.	**2.** This area must be lockable when unstaffed. Provide an intrusion alarm system.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation: Acoustical comfort for a nondisruptive environment.	**4.** Adjacent room walls should limit sound transmission to 40 decibels.	
5. Adequate lighting.	**5.** Lighting should be: 20 footcandles (ambient) and 70 footcandles (task).	
6. Environmental control for proper storage of electronic equipment.	**6.** Regulate temperature at 68°F (heating), 78°F (cooling), with a 5-cubic feet per minute per person outside air ventilation rate.	**6.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Supply 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and for every 10 linear feet of wall. Required frequency levels are 50 to 60 hertz ± 5 percent.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**8.** Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



7 -- speaker in ceiling



guidance

1. Loading platform

Provide a concrete loading platform adjacent to the storage area. The loading platform will be level with the storage area floor. It should be designed for a minimum load of 250 pounds per square foot and should provide adequate room to maneuver equipment.

Locate parts between the exterior receiving dock and maintenance room.

Provide an open area for unpacking equipment before it is moved into operation/equipment rooms.

2. Door security

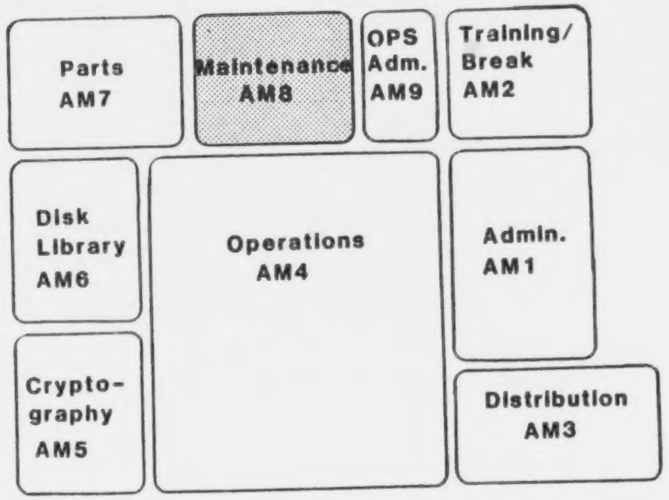
Maintenance/utility entrance doors not permitting ingress to administrative/operational spaces should be secured with heavy cylindrical case lock and latch sets in conformance with Federal Specification FF-H-106 and with the provisions of Builders Hardware Manufacturers Association Standard 601. Doors and hatches that are externally accessible and that provide access to critical utilities should be secured with padlocks and hasps in conformance with Military Specification MIL-P-43607 instead of or in addition to the cylindrical case or bored locksets specified above. (5) 3-5-9

Hardware set for secure doors should be:

- 1/8-inch-thick drill-resistant hard plate on interior of side door.
- Secured-type hinges.
- Cipher lock with an electronic access control, electric strike, and emergency battery standby.
- Combination lock.
- Door closer (on each leaf if pair door is required).
- Wide-angle peep hole.
- Foot bolt and pull-chain bolt for inactive leaf of pair doors.

No special security measures are required for the storage room if only computer paper, cards, and general office supplies are stored there.

MAINTENANCE AM8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AM3

function

This area is for assigned personnel and the shift supervisor who repair, clean, and test communication equipment.

policy/sop

1. It is desirable to provide a separate maintenance room with space for repair activities and the associated test equipment and tools. The space required will, of course, depend on the amount of C-E equipment installed, the number of maintenance personnel involved, and requirements for stocking spare parts.

2. To test and service a microwave communications system properly, maintenance personnel should have a thorough understanding of the equipment's physical makeup, operational characteristics, capabilities, and limitations, and should be familiar with the circuit theory of operation. It is equally important that the proper test equipment be available to these personnel. As the area of maintenance progresses from onsite field maintenance to depot maintenance, the quantity and requirements of the associated test equipment will increase, necessitating improved facility responsiveness. (70) 7-51

best copy available

Issues and assumptions

activities

1. Inspecting and diagnosing equipment and parts.
2. Completing preventive and unscheduled maintenance.
3. Assembling electronics.
4. Testing electronics.
5. Securing storage of parts and equipment.
6. Maintaining records on parts and equipment.
7. Writing and typing reports, PMI 349's, and equipment historical records.
8. Developing maintenance personnel training plans and initiating equipment evaluations.

personnel

1. Two or three maintenance specialists.
2. Maintenance noncommissioned officer in charge.

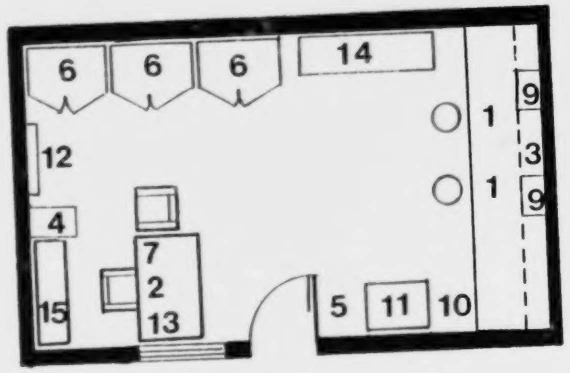
* see "guidance" box for example layout of all equipment listed.

equipment *

1. Two electronic workbenches with stools.
2. Two desks with chairs, one with a typing stand.
3. Shelving over workbench for publications.
4. File cabinet.
5. Portable vacuum cleaner to clean equipment parts. If compressed air blower unit is supplied instead, use 30 pounds per square inch maximum to prevent damage to parts. (Use with a dust collector.)
6. Locked storage cabinets secured to wall for special electronic equipment.
7. Typewriter or word processor.
8. Intercom speaker.
9. Wall-mounted test equipment over workbench.
10. Portable power supply test set.
11. Two scope carts.
12. Multiboard (24 by 48 inches).
13. Telephone.
14. Shelving for inactive equipment storage.
15. CRT terminal

requirements	criteria	commentary
1. Enough space for inspection, disassembly, and reassembly of sensitive electronic equipment. Space must also accommodate administrative, tool, and part needs.	**1.** Provide approximately 500 square feet.	
2. A secure, controlled area.	**2.** The room should be lockable when unstaffed.	**2.** See Vol 2, SB7, Security (Zone 3) for more information
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation to eliminate C-E equipment noise to help personnel concentrate when they work on electronic components.	**4.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC. 90, floor surface at NRC .50, and divider partitions (if used) at .85.	
5. Adequate lighting.	**5.** Fixtures should provide 70 footcandles for ambient lighting and 150 footcandles for task lighting.	**5.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical Lighting.
6. Thermal regulation and other comfort features for occupants.	**6.** Regulate temperature at 68^{O}F (heating), 78^{O}F (cooling), with a 5-cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adustment, casters, swivel, and independent backrest adjustment.	
7. Electrical power.	**7.** Install 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height for every 10 linear feet of wall. Provide four duplex outlets at each workbench. All equipment and workbenches must be grounded. Frequency levels should be 50 to 60 hertz ± 5 percent.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**8.** Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance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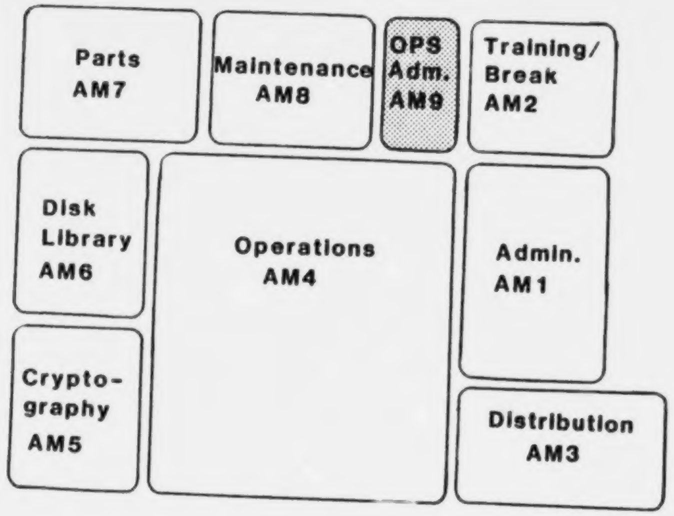
8 -- speaker in ceiling

guidance

OPERATIONS ADMINISTRATION AM9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Crypto-
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Distribution
AM3

function

To provide administration space that specifically supports the operations activities.

policy/sop

1. Communications equipment maintenance requires specific information to be logged into a maintenance report, specifying type of work accomplished, equipment used, equipment history, and parts used (inventory).

issues and assumptions

1. Automated equipment information

Upgrading the system with in-house automated equipment would help maintenance personnel's responsiveness. CRTs maintenance is a major function at communication facilities; therefore, large amounts of information are generated. An automated records system is needed for:

a. Equipment histories (for quality control).

b. Automated parts inventory.

c. Manuals and specifications.

d. Fault isolation for maintenance work by having the proper procedures on call.

2. Enclosed office versus open area workstation

Present noncommissioned officers in charge (NCOICs) and the assistants usually occupy an office workstation in the operations room itself. This makes their work more difficult because of the high noise and activity levels. If an enclosed office is provided, a view window to the console area must be provided.

activities

1. Distributing directives, orders and policy statements both written and verbal, to shift supervisors.
2. Initiating evaluation of equipment capabilities.
3. Developing personnel training plans and equipment evaluations.
4. Conferring with personnel (one-to-one).
5. Writing and typing reports.
6. Communicating operations and service functions.
7. Managing the operations function.
8. Planning for exercises and contingencies.

personnel

1. Operations NCOIC.

equipment *

1. Desk with chair.

2. Typewriter.

3. File cabinet.

4. Shelving for manuals and specifications.

5. Telephone.

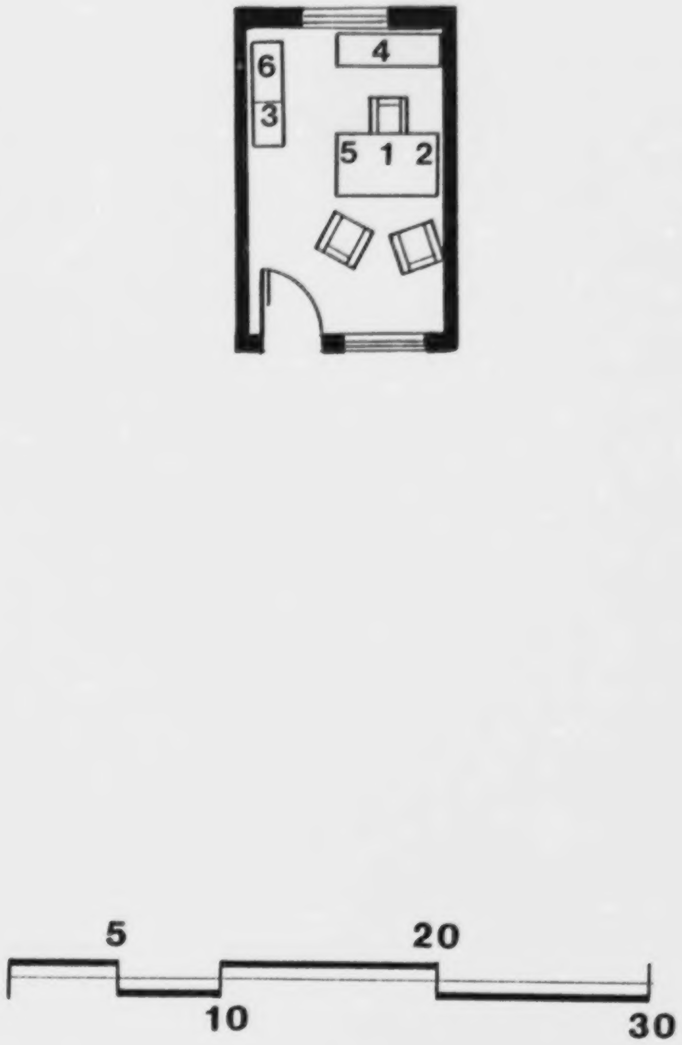
6. Bookshelves--30 linear feet.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate the equipment and furniture associated with the administrative function.	**1.** Provide approximately 150 square feet.	
2. Visual contact from offices to the operations floor to provide management with better opportunities to optimize personnel effectiveness.	**2.** Locate the administrative office space adjacent to the operations center console.	
3. Communication lines (outside and inside) for emergency operations and internal interaction between offices and operations floor.	**3.** Coordinate telephone and intercom needs with the installation.	
4. Interior finishes suitable for durability, maintenance, and room function.	**4.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**4.** See also Vol 2, "Site and Building Information," SB2, Interior Construction and Finishes.
5. Acoustical isolation and attenuation for a nondisruptive environment.	**5.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .90, floor surface at NRC .50, and divider partitions (if used) at .85.	
6. Adequate lighting.	**6.** Use artificial lighting or natural if present. By quantitative and qualitative evaluation, provide: 20 to 30 footcandles general lighting 60 to 80 footcandles task lighting. Surface reflectances: Ceiling--80 to 90 percent Walls--40 to 60 percent Floors--20 to 40 percent.	**6.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical Lighting.
7. Thermal comfort.	**7.** Regulate temperature at 68°F (heating), 78°F (cooling), with a 5-cubic feet per minute per person outside air ventilation rate.	**7.** See also Vol 2, SB2, communication Station Buildings--Mechanical.
8. Electrical power.	**8.** Install 120/208 electrical service. Receptacles (120-volt) should be located for convenience at each workstation and workbench at a suitable height for every 10 linear feet of wall. Electrical power must fall within the 10,000- to 500,000-watt range. Frequency levels should be at 50 to 60 hertz ± 5 percent.	**8.** See also Vol 2, SB2, Communication Station Buildings--Electrical.

requirements	criteria	commentary
9. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe fire loss potential.	**9.** Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**9.** See Vol 2, Standardized Modules--Building Design Principles, and SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

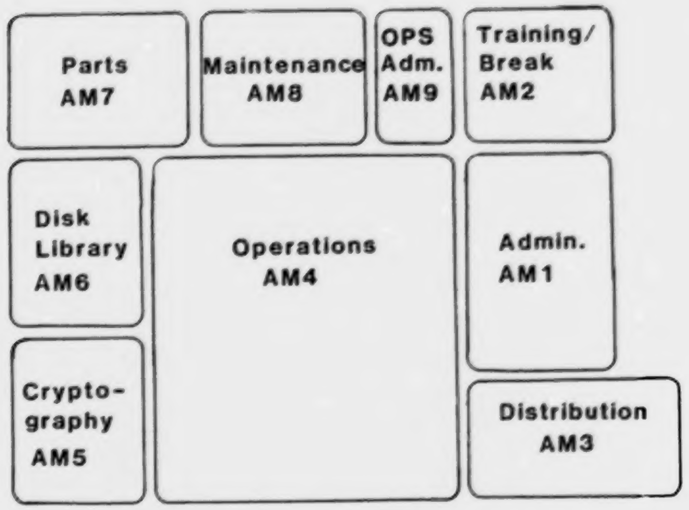
6. Work area

Light fixtures that provide uniform intensity should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. The work area should also be provided with adjustable task lighting.

guidance

guidance

STANDARDIZED MODULES AM10



building design principles

1 Efficiency of Operational Functions
- A. Communication equipment aligned for surveillance and access.
- B. On-the-job training on operating equipment.
- C. Interaction of operational support activities.
- D. Accessibility of toilets for operations personnel.

2 Integration of Parts/Maintenance Modules with Operations
- A. Parts/maintenance modules continguous to operations spaces.
- B. Loading dock accessibility for equipment and supplies.

3 Accessibility of Administration and Personnel Support Spaces
- A. Administrative transition space between public areas and secure spaces.
- B. Efficiency of integrated administrative spaces.
- C. Change of environment for on-duty personnel.

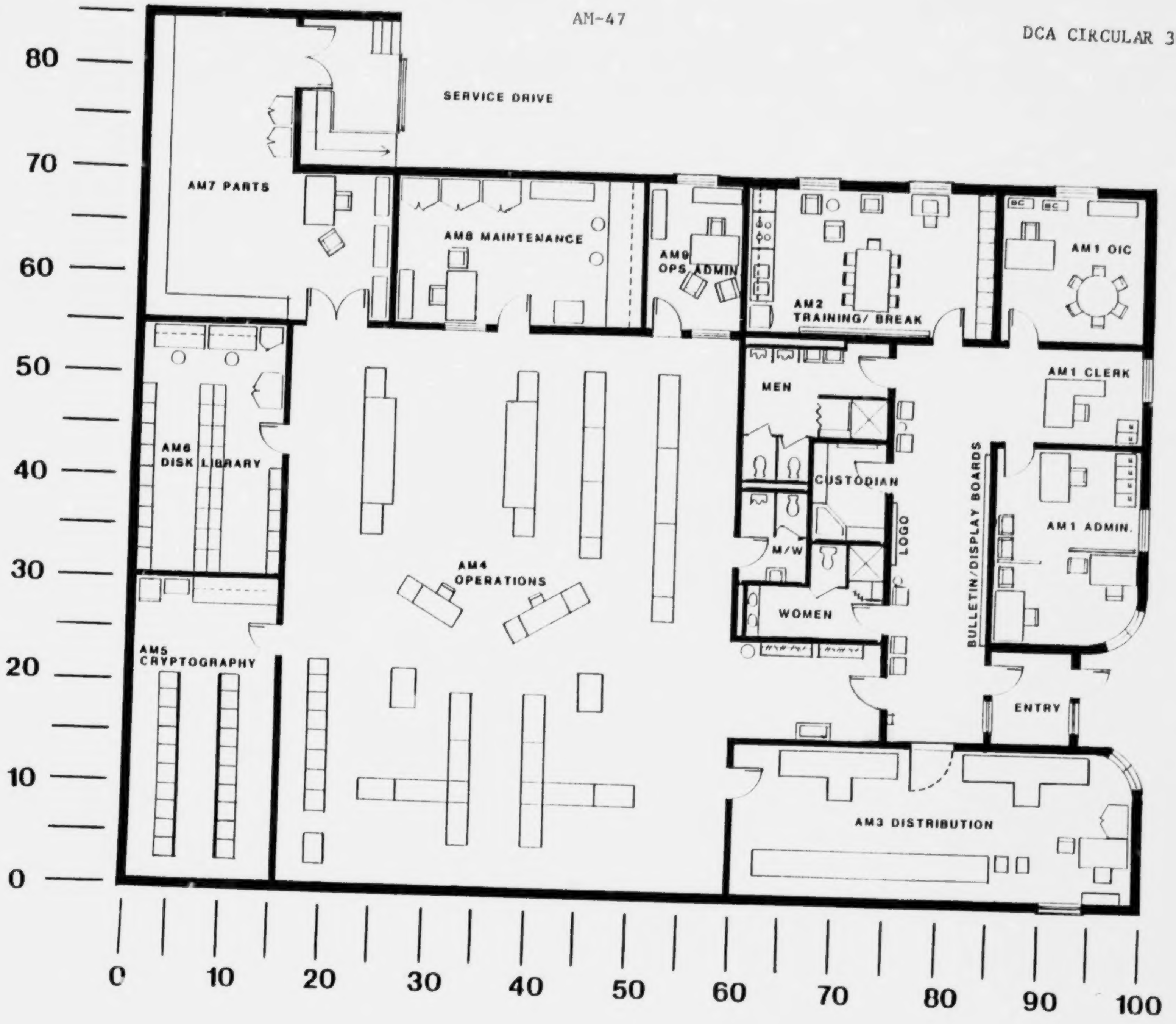
4 Facility Expansion
- A. Expansion potential in new construction operations space.
- B. Minimizing impact of future operations space expansion.

5 Security Operation
- A. Location of security space to control building access.
- B. Message security in operations and cryptography modules.

6 Facility Security/Survivability
- A. Required vault construction for commication system equipment.

7 Fire Protection
- A. Fire protection Classifications; occupancy, hazard of contents, sprinkler protection and construction/materials.
- B. Building separation distances.
- C. Fire protection systems; automatic fire suppression, automatic notification/alarm, and automatic fire detection.

8 Life Safety
- A. Occupant load determination.
- B. Protected exit conditions; exit capacities, number of exits, exit travel distances, and arrangement of means of exit.
- C. Allowable interior finishes.
- D. Egress path identification; illumination of means of egress, emergency lighting, and marking of means of egress.


SERVICE DRIVE
AM7 PARTS
AM8 MAINTENANCE
AM9 OPS. ADMIN
AM2 TRAINING/ BREAK
BC
BC
AM1 OIC
AM1 CLERK
MEN
AM6 DISK LIBRARY
CUSTODIAN
LOGO
BULLETIN/DISPLAY BOARDS
AM1 ADMIN.
M/W
AM4 OPERATIONS
WOMEN
AM5 CRYPTOGRAPHY
ENTRY
AM3 DISTRIBUTION
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70
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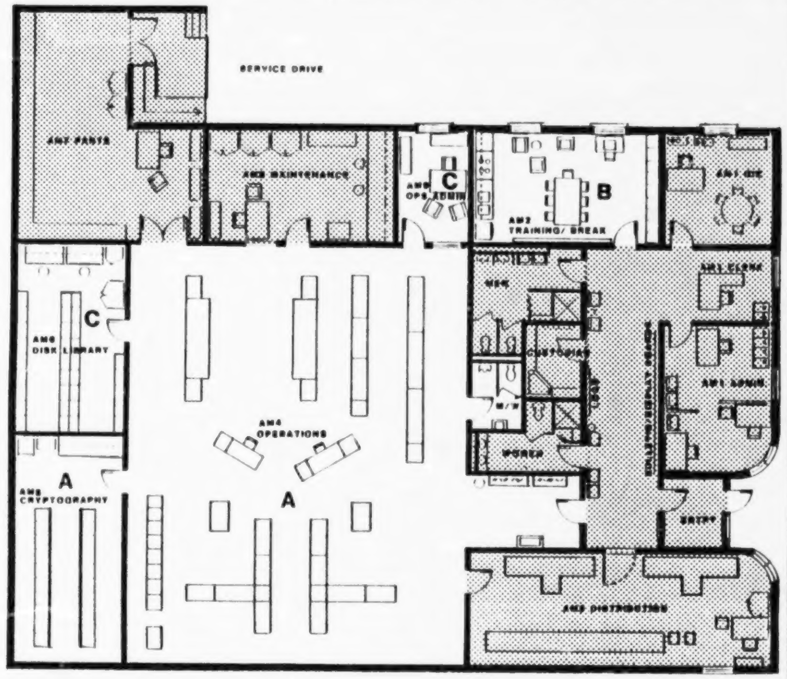
guidance 1. Efficiency of Operational Functions


SERVICE DRIVE
AM7 PARTS
AM8 MAINTENANCE
AM8 OPS ADMIN
C
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AM2 TRAINING/BREAK
AM1 OIC
AM1 CLERK
AM1 ADMIN
C
AM6 DISK LIBRARY
A
AM6 CRYPTOGRAPHY
AM4 OPERATIONS
A
MEN
WOMEN
ENTRY
AM5 DISTRIBUTION

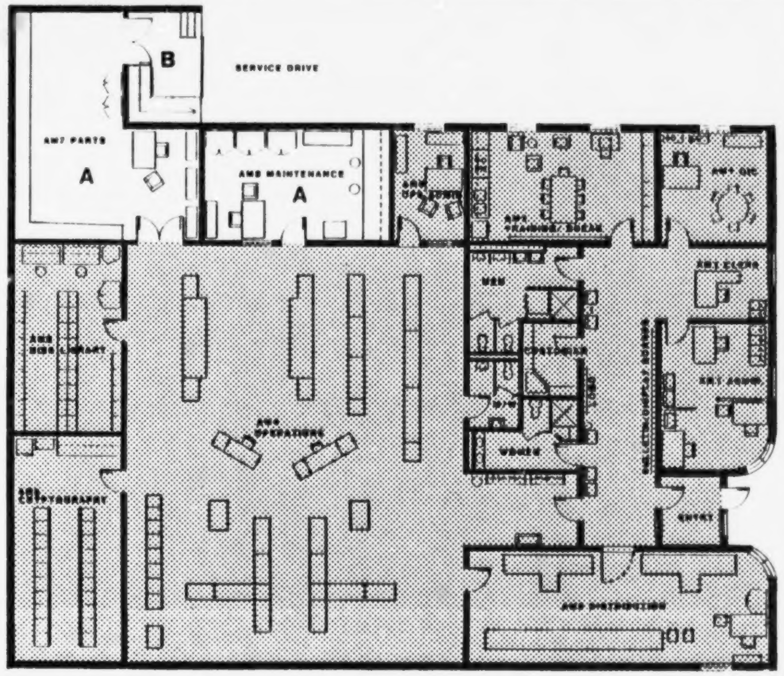
A Equipment should be aligned in parallel rows within the operations modules for ease in visual surveillance and to provide direct access to all critical equipment. Multiple consoles should be adjacent to each other so that limited personnel can monitor them efficiently at one central location. Tables for audiovisual training aids should be available in operations modules so that personnel can train on-the-job during regular watch periods.

B To further enhance the effectiveness of on-the-job training, instruction can be done in small groups of four or five in a training room for hands-on experience with communications equipment. This requires a close relationship with the operations module.

C Additional building modules with a close functional relationship to operations activities should be located adjacent to the operations module.

D Toilet facilities should be nearby for personnel in the operations module.

guidance 2. Integration of Parts/Maint. Modules with Ops.


B
SERVICE DRIVE
AM7 PARTS
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AM8 MAINTENANCE
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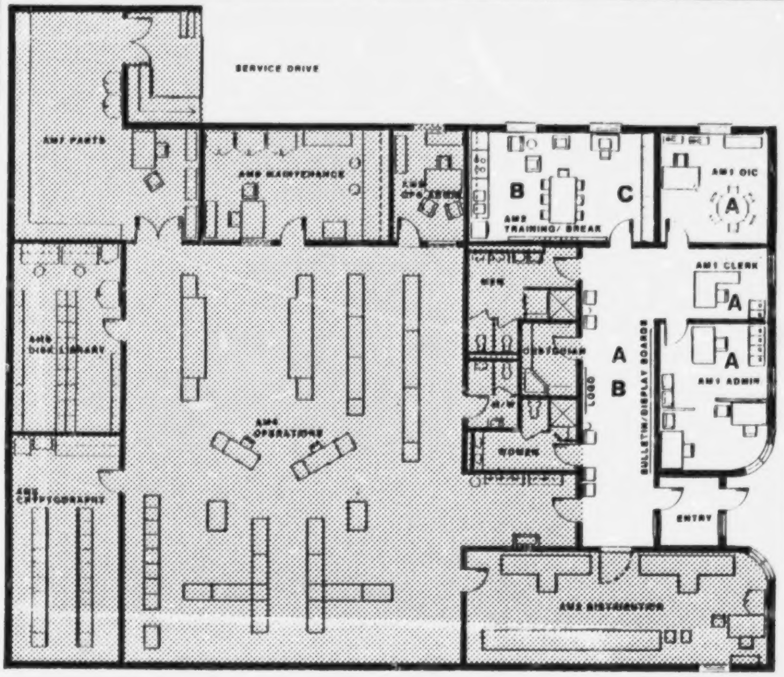
AM8 OPS ADMIN
AM2 TRAINING/BREAK
AM1 OIC
AM1 CLERK
AM1 ADMIN
AM6 DISK LIBRARY
AM4 OPERATIONS
AM6 CRYPTOGRAPHY
MEN
WOMEN
ENTRY
AM5 DISTRIBUTION

A Parts and maintenance modules should be well integrated and contiguous with the operations spaces to optimize efficiency and minimize circulation. The secure door between the operations and the maintenance/parts spaces is used only as a fire exit and to bring communication equipment in from and out to the loading dock. This door should have opening hardware only on the secure side.

B Parts and maintenance from modules must be located within an organizational context such that deliveries can be made to the total building in a direct and secure process at a loading dock. The large communication equipment can be moved in and out more easily using the loading dock. (Also, in multistory communication buildings, an elevator should be located adjacent to the parts module for safe vertical movement of large communication equipment throughout the building.)

guidance 3. Efficiency and Accessibility of Admin. Spaces

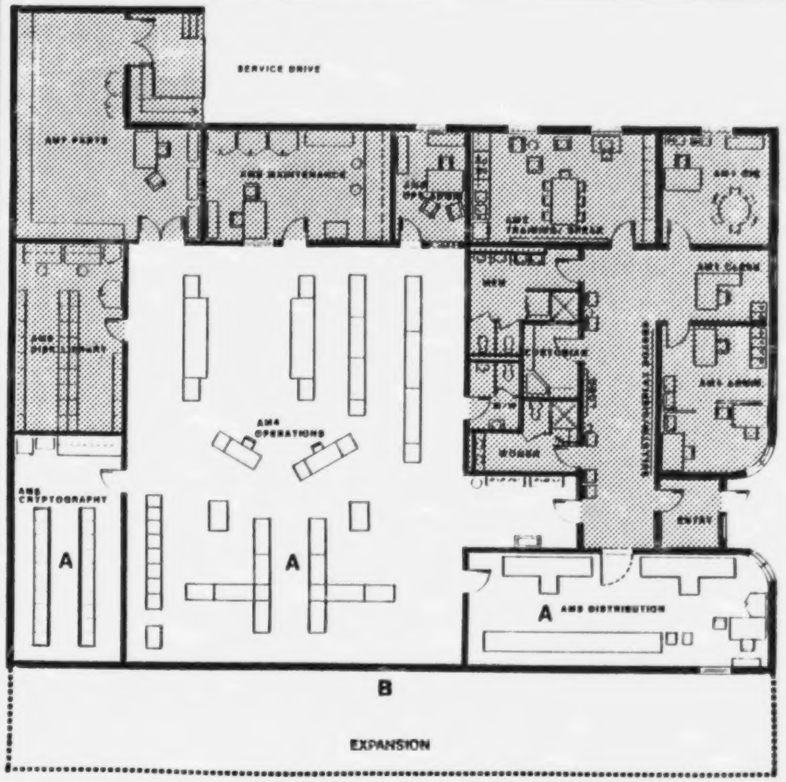


A Administration modules must be easily accessible to the public to minimize circulation and to prevent visitor interference with facility operations. The administration modules should provide a buffer and transition space between the exterior and interior secure spaces. Also, public corridors in the administration area should contain military unit logos and other display panels that relate to the "esprit de corps" and unit integrity of the communication station.

B Administration spaces' integrated relationship will improve efficiency by minimizing public and administrative circulation and by producing a group adjacency to shared conference areas, secretaries, and waiting areas.

C The intense activities inside the DCS facility tend to generate personnel mental fatique. Therefore, it is necessary to create a change of environment for on-duty personnel as a break from the "hard surface" equipment room and work areas. The personnel support module should be directly adjacent to the operations, but isolated acoustically and visually.

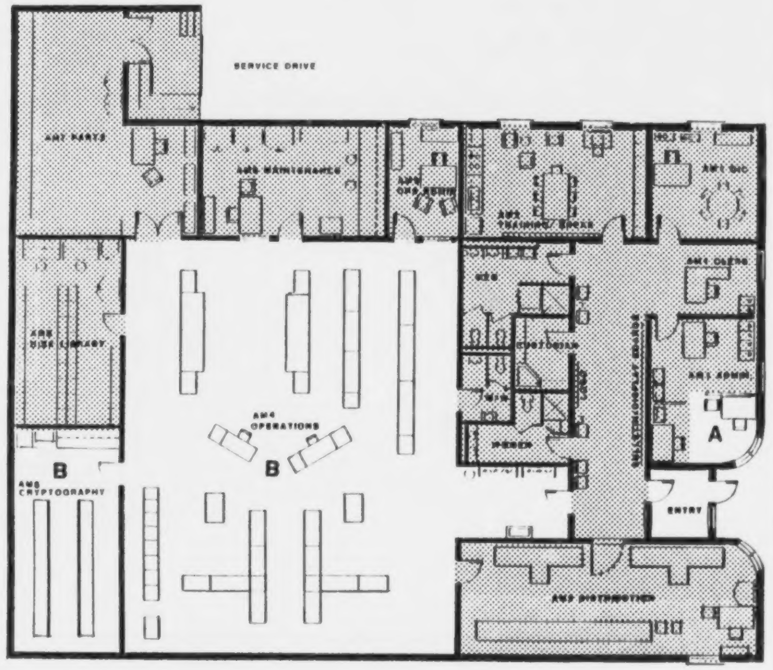
guidance 4. Facility Expansion



A The equipment layout should be planned in a way that affords enough space for the installation of equipment capable of handling the maximum projected traffic load. The initial equipment layout should be such that the station facility's ultimate expansion can be done without extensive rearrangement of existing equipment.

B Operations modules should be functionally isolated from support and power modules. Because of the increasingly rapid changes in communications technology, new demands on the spatial layout of operations modules can be expected in the future. Such spaces must be able to expand to accommodate new equipment and new functions. It is not anticipated that support and power spaces will need this same expansion capability and, therefore, may be located in their own areas; that is, facility design should allow operations modules to expand without greatly affecting the remaining functions.

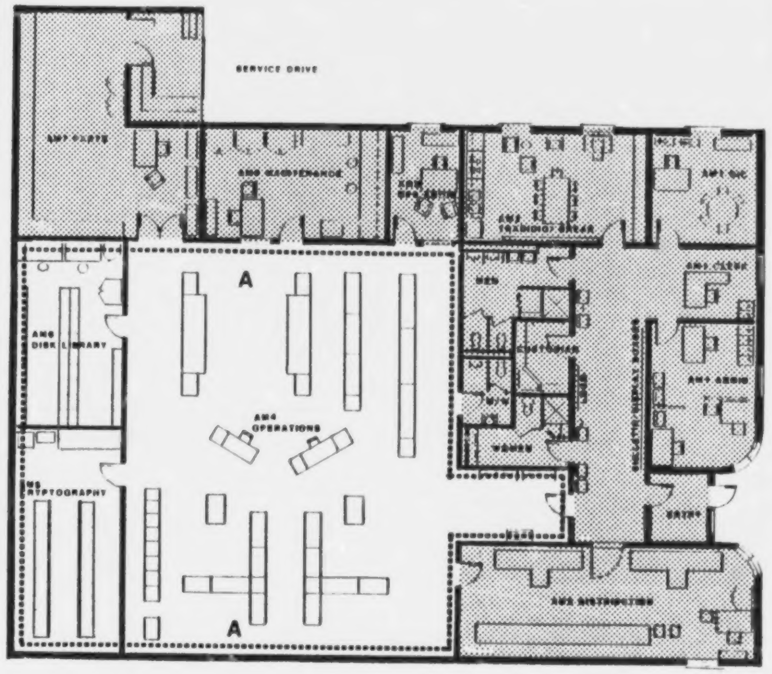
guidance 5. Security Operation


SERVICE DRIVE
AM6 DISK LIBRARY
AM4 OPERATIONS
B
B
AM8 CRYPTOGRAPHY
A
ENTRY

A The security module will administer site security, monitor all intrusion detection systems, and initiate proper reactions to hostile threats. The security module should therefore be designed to provide overview and control over both site access and all exterior activities.

B "Message" security is achieved by minimizing circulation between operations and cryptography modules, confining the modules to controlled areas, and providing disposal techniques to be performed or controlled by authorized personnel.

guidance 6. Facility Security/Survivability


SERVICE DRIVE
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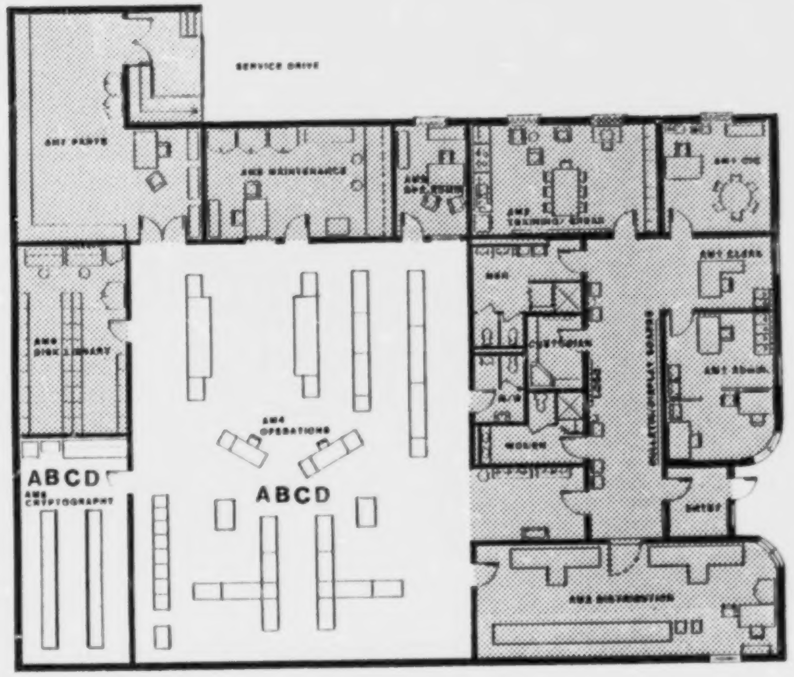
AM6 DISK LIBRARY
AM4 OPERATIONS
AM8 CRYPTOGRAPHY
A

A Conventional Class A vault construction is required for all spaces containing the communication system equipment--for example, operations, equipment, and tech control. Therefore, efficient construction methods and future building flexibility requirements can be met by locating these spaces in a contiguous relationship. These spaces usually require vault-type construction for a combination of four requirements: (1) HEMP protection, (2) TEMPEST shielding, (3) building intrusion resistance, and (4) fire protection. (See SB7, Security Systems--guidance for building security construction of Zone 4, Section 5b in Vol 2).

guidance 7. Fire Protection



Occupancy classifications: Business (NFPA); B-2 (UBC)

Hazard of contents classification: Ordinary hazard

Sprinkler protection classification: Ordinary hazard--group 2.

Construction classifications/materials for fire protection (See Vol 2, the first figure in SB3, Fire Protection/Life Safety)

A Type II--One-Hour (UBC) for battery, cryptography (RED/BLACK),* custodian, generator, operations,* mechanical, and transmission spaces:

All construction elements.......1-hour rated construction

Type II--N (UBC) for remainder of building spaces

All construction elements.......Noncombustible construction

Building Separation

Site-specific information is required. Comply with the second figure in Vol 2, SB3, Fire Protection/Life Safety.

Interior finishes

See Guidance/Life Safety, Vol 2.

Fire protection systems

B Automatic fire suppression

A water sprinkler system shall be provided throughout the entire facility.

A Halon 1301 or carbon dioxide system shall be provided under raised floor areas containing nonmetallic, sheathed, exposed cables when the space under the raised floor is used as an air plenum.

C Automatic notification/alarm

A general alarm must be activated by the automatic sprinkler system.

Local alarms are required to sound only in the designated spaces; they are activated by smoke detectors.

D Automatic fire detection

Smoke detectors are required to activate local alarms only in the designated spaces. In rooms containing raised floor areas, smoke detectors shall be located under the raised floor.

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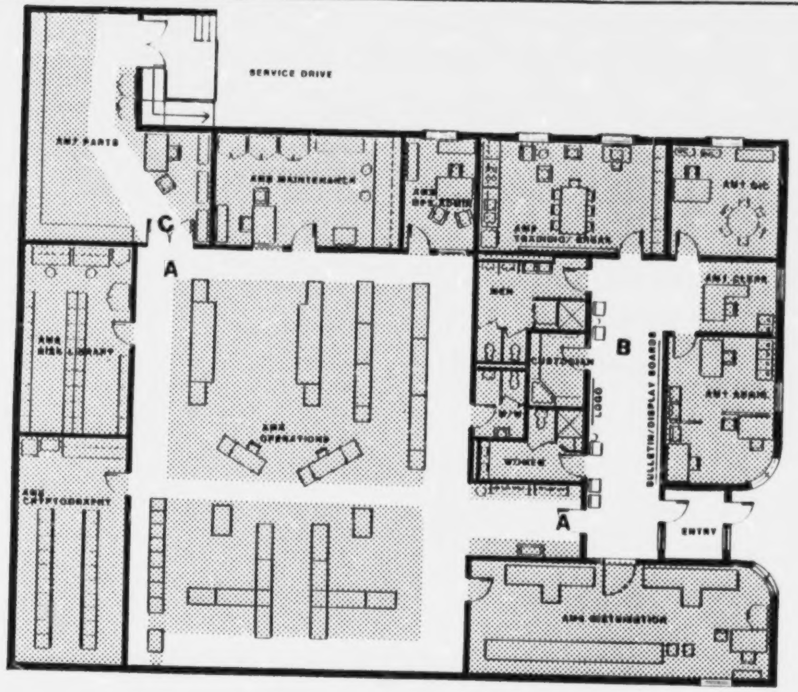
*See Vol 2, SB7, Security, for vault construction requirements that may be more stringent than those imposed by fire protection requirements.

guidance 8. Life Safety



OCCUPANT LOAD FOR DETERMINEING EXIT REQUIREMENTS.

Occupant load factor: 100 square feet per person based on gross floor area (Business Occupancy-NFPA)

Occupant load (total facility) $= \frac{7155 \text{ sq ft}}{100} =$ 72 persons

Occupant load (vaulted area) $= \frac{3450 \text{ sq ft}}{100} =$ 35 persons

Occupant load (admin/support) $= \frac{1980 \text{ sq ft}}{100} =$ 20 persons

Exit capacities

Corridors--100 persons per unit of exit width for travel in either direction. The minimum width of any exit access corridor or passageway shall be 44 inches in the clear.

Doors--100 persons per unit of exit width (a 3-foot door provides 1.5 units of exit width, providing an exit capacity for 150 persons).

Number of exits

No less than two exits shall be accessible from every part of every floor. One exit is permitted when the room or area has: (1) a total occupant load of less than 100 persons, (2) direct exit to an open area outside the building at the ground level, and (3) a total travel distance on the same level of not over 100 feet. (If stairs are involved, they shall be no more than 15 feet in height and shall be provided with complete enclosures to separate the stairs from any other part of the building.)

Exit travel distances

Required exits shall be located to allow access without passage through areas that may be locked. No dead end corridor shall exceed 50 feet. Travel distance to exits shall be no more than 300 feet when the building is protected throughout by an approved automatic sprinkler system.

Arrangement of means of egress

A Exit access and travel routes to exits are shown in the plan.

Exit doors in vaulted areas that contain communications equipment are secured and permit egress out only. Exit access routes through vaulted areas from spaces outside the vaulted area are not permitted for security reasons.

Interior finishes

B Interior finish in exit access corridors shall be Class A only. Interior finish in the rest of the facility shall be Class A or B only.

guidance

Means of egress lighting

Exits and exit access, including stairs, aisles, corridors, and passageways leading to an exit, shall be lighted continuously during times when the conditions of occupancy require means of egress to be available. Lighting should be no less than 1 footcandle measured at the floor.

Emergency lighting

Emergency lighting shall be provided in windowless buildings for designated aisles, corridors, and passageways leading to an exit. Emergency lighting shall stay at least 1 footcandle throughout the means of egress for 1.5 hours in the event of normal lighting failure.

Marking the means of egress

Exits shall be marked by an approved sign readily visible from any direction of exit access. Signs shall be placed such that no point in the exit access is more than 100 feet from the nearest visible sign.

C Doors located or arranged so that they are likely to be mistaken for exits shall be identified by a sign reading "NOT AN EXIT."

In April 1982, as a result of an intensive internal study of alternative systems, the Department of Defense (DOD) directed that the Defense Data Network (DDN), based on ARPANET technology, be implemented as the DOD common-user data-communications network. Office of the Secretary of Defense policy issued 10 March 1983 states:

> All DOD ADP systems and data networks requiring data communications services will be provided long-haul and area communications, interconnectivity, and the capability for interoperability by the DDN. Existing systems, systems being expanded and upgraded, and new ADP systems or data networks will become DDN subscribers. All such systems must be registered in the DDN User Requirements Data Base (URDB). Once registered in the URDB, requests by a Service/Agency for an exception to this policy shall be made to DUSD (C31). Requests for exceptions for joint interest systems shall be routed to DUSD (C31) through the JCS.

Packet switching is a method for handling data as they are transmitted through a communications network. The switching nodes to which subscriber computers are attached subdivide information streams into small packets, then route and otherwise handle each packet as if it were a separate message.

Each switching node receiving a packet from a neighbor node checks for errors and, should an error be found, requests retransmission from the neighbor until the data are received correctly. The node then either forwards the packet to another node or delivers the packet directly to the addressee.

The more advanced packet switching networks, such as DDN, route packets adaptively instead of using predetermined paths. With predetermined routing, data cannot be forwarded easily if any network component fails in the path over which the data must pass. With adaptive routing, switching nodes avoid portions of the network that are congested or damaged.

Packet switching is particularly well suited to military data communications and was developed specifically for computer communications. It can support the real-time communications required by computer systems and can provide the high levels of circuit use required by cost-conscious system designers and managers. Furthermore, because packet switching nodes typically can operate without an attendant, and because they are small, reliable, and inexpensive, they can be installed in large quantities and at many locations, thus providing substantial survivability. Because of these characteristics, packet switching has been implemented in several military and commercial networks.

The DDN will evolve into a fully integrated network, as shown in Figure DD-1.

The DDN currently consists of the MILNET, the WIN Communications Subsystem (WINCS), and the Movements Information Network (MINET). Also being developed are the Strategic Air Command Digital Network (SACDIN), the DOD Intelligence Information System (DODIIS), and a new SECRET level network which will form the backbone of the classified segment.

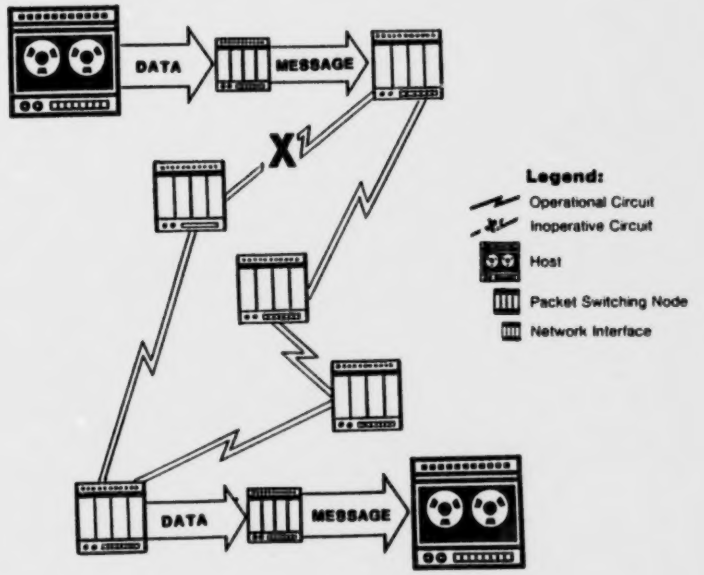
In the near future, the MILNET and MINET networks will be integrated, becoming the unclassified backbone segment. The residual ARPANET will continue as a facility for network research.

Over the next few years, as end-to-end encryption (E3) security devices become available, the DODIIS, SACDIN, WINCS, and other Top Secret subscribers will be integrated with the SECRET backbone, forming the classified segment of the DDN.

In order to permit classified users to exploit the large bandwidth of the DDN's unclassified segment, the classified and unclassified DDN segments will be interconnected using one-way network gates (switch-level gates). This will result in establishing the segmented DDN.

Finally, the availability of NSA-developed BLACKER equipment will allow the segmented DDN to be integrated into a single, shared, multilevel secure network, and will allow the InterService/Agency Automatic Message Processing Exchange (I-S/A AMPE) subnetwork and other multilevel secure hosts to use the DDN as a backbone.

FIGURE DD-1. PACKET SWITCHING NETWORK.



DDN EQUIPMENT DD1

DD1
DDN Equipment

function

To provide the space and utility systems needed to install and operate the DDN node site equipment.

policy/sop

1. The Military Departments (MILDEPs) have been directed by DOD policy to satisfy all requests for data communication services by using the DDN. This system will be the single, integrated packet-switching network designed to meet the DOD's data communication requirements. (193) 1

2. DDN will provide all DOD ADP systems and data networks requiring data communications services with long-haul and area communications, interconnectivity, and the capability for interoperability. Existing systems, systems being expanded and upgraded, and new ADP systems or data networks will become DDN subscribers. All such systems must be registered in the DDN User Requirements Data Base (URDB). (194) 1

   Elements of the network are grouped into two functional areas: (a) the network backbone, consisting of the trunk circuits and packet switches, and (b) the access network, which consists of circuits and interface equipment that enable subscriber computers to connect with the backbone. Furthermore, DDN has two network-wide functions: (a) safeguarding the security and privacy of subscriber traffic and (b) monitoring and controlling network performance. (191) 5

3. The DDN is designed to survive damage as well as, or better than, the subscriber activities it supports. Five network features will enable the DDN to continue providing service to subscribers even when the system is partially damaged: (a) as much of the network equipment will be in facilities at least as survivable as the facilities of subscribers relying on the equipment, (b) critical equipment and circuits will be configured redundantly, (c) if the network is damaged, the service quality will degrade gracefully via the adaptive packet routing algorithm, (d) geographically dispersed nodes are used, and (e) highly flexible control mechanisms are used. (191) 9

4. The DDN will safeguard the security of transmitted traffic by using link encryption, end-to-end encryption, and physical and procedural security measures. The traffic of each user community will be separated cryptographically from that of other communities. Each subscriber access line to the DDN must operate at a single, system-high security level (for example, "unclassified," "secret," or "top secret"). Furthermore, the traffic from subscribers handling special categories of top secret will be encrypted using a different key than other traffic classified as top secret. Thus, the network will totally segregate traffic (from a cryptographic standpoint) into at least five different user communities.

5. IPLIs will insure that the traffic from different security levels or communities of interest are kept separate. There will be at least one IPLI key for each community. Thus, through end-to-end encryption, each network user will be able to communicate only with other users belonging to the same subscriber community; that is, other users who have and use the same cryptographic key. When BLACKER technology becomes available in the late 1980s, DDN will operate as a multilevel secure system. (191) 11

6. In the past, organizations in DOD have acquired various makes of computers and terminals that cannot communicate with each other. In the future, the DDN will enable these organizations' hosts and terminals to interoperate. To do so, however, will require that the hosts have software suitable to implement the required protocols:

- Transmission Control Protocol/Internet Protocol (TCP/IP)--protocols that permit end-to-end data flow between two computer systems or between a host system and a TAC.
- File Transfer Protocol (FTP)--protocol that enables files to be transferred between computer systems.
- Telnet--virtual terminal protocol to which traffic from different terminal types is converted, resulting in the use of a common virtual terminal format throughout the network.

Moreover, to be interoperable, subscriber systems must conform not only to these protocols but also must have application programs that make use of these protocols. Subscriber host systems and their applications must conform to TCP/IP in order to interoperate. (191) 13

7. Applications programs in subscriber host systems with TCP/IP and Telnet will be able to exchange information both with TACs and application programs in DDN host systems that support TCP/IP. TCP/IP will enable subscriber systems to establish communications with each other, control the rate of information flow between systems, and detect and correct errors. Communication between application programs in different hosts requires that these programs either communicate via TCP/IP or use other interoperability protocols such as FTP, which in turn communicate via TCP/IP. Subscriber systems can use Telnet to interoperate with any DDN terminal treated as a network virtual terminal. DDN will support many terminals that will operate with compatible host systems. In addition, the DDN will enable a few types of widely used terminals to operate not only with compatible host systems, but also with host computers with which they were not intended to operate. Such interoperability will be possible with subscriber systems that conform to the Telnet protocol. At the host, all terminal transmissions will be converted to look like a "standard" network virtual terminal. At each TAC, specific device handlers for each type of terminal attached to the TAC will provide protocol conversion between the Telnet protocol format and a format acceptable to the terminal. (191) 13

8. DDN subscribers will be able to connect their host computers to the DDN with one of two types of interfaces:

a. A full service (FS) interface, of which there are two versions, and

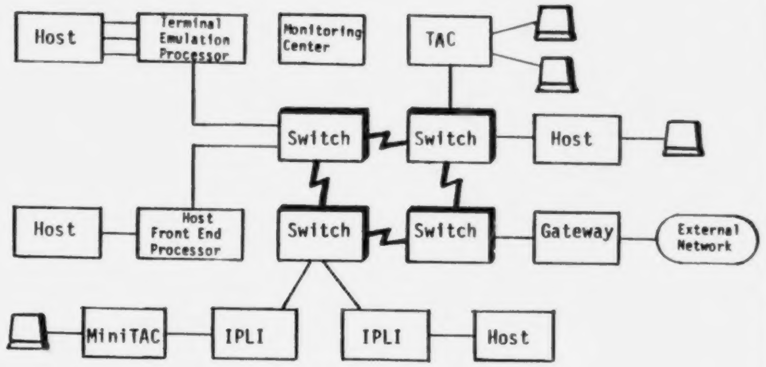
b. A terminal emulation processor (TEP) interface.

Both interfaces will enable hosts to exchange information with compatible terminals connected to the DDN. (191) 15

9. Prospective DDN subscribers operate thousands of terminals of many different types. The DDN will support the more popular types, including both asynchronous and synchronous terminals. The transmission speed for terminals can be as high as 19,200 bps.

The many terminals that DDN will support will be connected to DDN directly by a TAC or through their hosts (Figure DD-2). Many terminal types will be able to interoperate with several makes and models of host computers; the rest will interoperate only with host models with which they are compatible. Terminals will access the DDN directly through TACS or indirectly through host computer systems. (191) 17

FIGURE DD-2. DDN COMPONENTS.



issues and assumptions

1. Self-contained versus integrated node installations

The DDN concept is to install a turnkey system for the services and participating agencies (hereafter referred to as "Service"). There are two types of installations. The first is a "self-contained node" (SC-node) which requires only that the supporting Service present both signal and power cables to the immediate SC-node's vicinity. The second is the "integrated node" (I-node) which allows the supporting Service to integrate the DDN node equipment into an existing technical control or other facilities, and requires the Service to provide and install all connections to and from any of its distributed site functions. In either case, the node shall not be required to be attended, but shall be installed in facilities that are staffed on a 24-hour basis.

a. Self-contained node installation. This type installation requires that the Service provide DDN with suitable physical space at one location served by sufficient signal and power cables. For SC-node installations, the demarcation point is at the connector on the end of the 200-pair TELCO cable at the node and at the TAC fantail. If the Service elects to terminate the signal cable on a nearby TELCO cross-connect block, the demarcation point is at that block. Generally, the Service will be required to provide TELCO-type equipment and individual breaker-protected power circuits. These facilities are expected to be in the immediate vicinity (within about 6 feet) of the node. DDN SC-nodes will have limited patch and jack capabilities, but will have no patch and test capabilities.

b. Integrated node installation. This installation has the DDN equipment distributed (or integrated) with existing equipment and is implemented only if the Service requires that the DDN signals pass through their existing patch and test (or like) facility. An I-node also should be used when "preparation" is taken to mean extreme cable run distances (over 50 feet), penetration through masonry walls or floors, and/or inclusion of separate rooms--for example, model and crypto rooms.

If the Service selects the integrated node installation, it assumes responsibility for providing and installing all connections to and from the integrated components. For I-node installations, the demarcation point between services and DDN-PMO responsibility for data connections will be at the first connector encountered within the DDN node equipment racks in any connection between services and DDN equipment. (PMO = Program Management Office.) When power is directly to a service box, the demarcation point for power is at that box. Specific demarcation points will be identified and documented at the site survey. DDN will provide all equipment which otherwise would have been provided, but the Service will assume installation responsibility. In this case, the DDN contractor will have diagnostic authority and will have access to all elements of the integrated installation. (194) Encl. 2

issues and assumptions

2. Determining the correct shielding procedure

A comprehensive approach to shielding equipment from radio frequency interference (RFI) or TEMPEST involves (a) a building layout to optimize inherent facility shielding conditions, (b) suitable location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components.

See Vol 2, SB4, for additional guidance.

3. Site preparation and installation process

As part of the site selection process, the DDN-PMO will issue a node site presurvey form that will be filled out and returned by the Service to document the nominated site's physical, technical, and administrative characteristics. For most installations, this survey form will also be incorporated into the site survey report and preparation plan.

CONUS site presurveys will be forwarded to the DDN-PMO, which will use these data to determine site suitability (for OCONUS sites, the presurvey will be forwarded to DCA-EUR or DCA-PAC, whichever applies). The Service will obtain engineering support as necessary to complete site preparation or planning activities (this support may be from the Services or contractors). The Service will appoint a node site coordinator and provide this individual's name, address, and telephone number with submission of the presurvey.

After the site presurvey form has been evaluated and accepted by the DDN-PMO, the actual site survey will be scheduled with representatives from the Service and DDN-PMO. This survey is a coordination and negotiation meeting to define site preparation and installation responsibilities and is the time to specify actual node equipment placement. The DDN representative will serve as moderator over option selection and will be responsible for preparing the site survey report and coordinating it through DCA and Service channels. The site survey report will be forwarded to the service O&M command within 10 working days. The O&M command will acknowledge receipt and contents of the site survey report before DCA ships equipment to the site. Node site preparation will be the responsibility of the supporting Service, as designated during the site survey visit and as described in the site survey report.

For most installations, the completed site presurvey form can serve as the site preparation plan, but in the case of I-node or other complex installations, more detailed planning may be required than is possible during the actual site survey visit. In this case, the DDN-PMO representative may ask for an extended site preparation plan. This plan will incorporate the site presurvey form together with an outline of all preparation tasks, a definition of responsibilities, and the proposed schedule for completion. The site preparation plan will be the preparation and execution responsibility of the Service as long as it is within the bounds documented in the site survey report. DCA will be offered the opportunity to comment on the draft site preparation plan.

issues and assumptions

4. Classified node

The classified node will be encrypted by the KG84A for processing classified traffic. This node uses a TEMPEST IMP.

activities

1. Monitoring communication equipment (patch and test).
2. Isolating faults.
3. Conducting quality control maintenance tests.
4. Troubleshooting and patching to good equipment; identifying bad connections.

personnel

1. One per shift.

equipment *

1. Processor cabinet.
2. Incryption cabinet or safe.
3. Communications cabinet.

* See "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to operate and monitor C-E equipment. Equipment must be spaced properly to facilitate maintenance.	**1.** The equipment will consist of three cabinets. See Guidance for a typical self-contained node site layout.	
2. Security for C-E equipment.	**2.** The classified equipment room must be able to be locked when unstaffed and must be supplied with an intrusion alarm system.	**2.** See Vol 2, SB7, Security (Zone 3) for more information.
3. Signal shielding.	**3.** Safeguards currently planned for classified nodes include: a. Link encryption. b. End-to-end encryption. c. Physical security at sites with packet switches. d. Use of a cryptographic authentication protocol. e. Use of only TEMPEST-approved equipment.	**3.** Link encryption will be used on all network backbone links, all access lines to remote classified hosts and TACs, and access lines to all monitoring centers. End-to-end encryption will be provided by IPLIs to safeguard classified information transmitted through the network. Furthermore, a cryptographic authentication protocol will be used for all traffic between monitoring centers and packet switches to prevent unauthorized transmission of switch-control messages. Moreover, packet switches in classified nodes will be placed in areas approved for handling and storing data that are classified at least at the Secret level. Unclassified nodes must be in facilities protected to at least the Restricted level. Finally, selected network elements will be TEMPEST-approved to ensure suppression of compromising electromagnetic emanations. The engineering of all classified node installations will be in accordance with NACSIM 5203. (191) 11

requirements	criteria	commentary
4. EMP/HEMP shielding.	**4.** Shielding is necessary for survivability and uninterrupted functioning in case the system is subjected to electromagnetic pulse (EMP) or high altitude electromagnetic pulse (HEMP). Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	**4.** See Vol 2, SB5, EMP/HEMP Protection for more information. Much of the DDN equipment will be located on the same premises as the subscriber equipment that it supports. Thus, it will be able to survive as long as the subscriber system can survive. DDN equipment that is not on subscriber premises will be made survivable in three ways. First, it will be placed, if possible, within hardened facilities or in nontargeted areas. Second, if appropriate, it will have HEMP protection in the form of electromagnetic shielding, line isolation circuits, and surge arresting components. When necessary, a UPS also will be provided so that operations can continue during transient power failures. Third, DDN circuits will be routed diversely and through nontargeted areas. (191) 9
5. Raised floor system.	**5.** Raised or false floors are necessary for proper cooling of the equipment and easy installation of power and signal cables.	**5.** See Also Vol 2, SB2, Communication Station Buildings--Architectural.
6. Interior finishes suitable for durability, maintenance, and room function.	**6.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor that has a dusted-on finish containing a hardener. Base--Glazed structural units of rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	**6.** See Also Vol 2, SB2, Interior Construction and Finishes.

requirements	criteria	commentary
7. Acoustical isolation and attenuation for variable noise levels produced by electronic equipment.	**7.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile is also required to within 4 feet of the floor.	
8. Adequate lighting.	**8.** Lighting shall be specially engineered. Low levels of lighting may be required to permit observation of luminous panels without reflected glare or undesirable contrasts in brightness. Separately controlled luminaires shall be provided for normally lighted operations with an ambient level of 70 footcandles using fluorescent fixtures.	**8.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical Lighting.
9. Environmental control for proper operation of electronic equipment.	**9.** All devices comprising a DDN node require constant circulation of air through the cabinets. This flow may be from subfloor air-conditioning plenums, by fan-driven ambient air, or by some other form of ducted air-conditioning. Air reaching the equipment should be maintained between 60° and 77°F with temperature changes limited to 39°F per hour. The air should have a noncondensing humidity level maintained between 30 and 80 percent. The air should be essentially dust-free, as for human occupation.	**9.** See Also Vol 2, SB2, Communication Station Buildings--Mechanical.
10. Electrical power.	**10.** Provide 120/208 electrical service with 120-volt outlets--one receptacle for every 10 linear feet of wall. Outlets for equipment should be available under the raised floor as per layout. Electrical power must fall within the 10,000- to 500,000-watt range, with a frequency level at 50 to 60 hertz ± 5 percent. Power installation to classified node areas will require a dedicated circuit for each TEMPEST IMP/TAC cabinet, communications cabinet, and encryption cabinet.	**10.** See Also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumption that this facility is windowless. In addition the facility houses critical equipment and data that would create a severe strategic fire loss.	**11.** Vaulted enclosure walls--2-hour (minimum) fire-rated shielded construction. Interior doors in vaulted walls: 1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Halon 1301 system. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area--Automatic fire detection: local alarm. Automatic Halon 1301 suppression system is required--cross-zoned or matrix detection. Sprinkler and Halon systems are not normally installed in the same areas.	**11.** See Standardized Modules --Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety for more information.

guidance

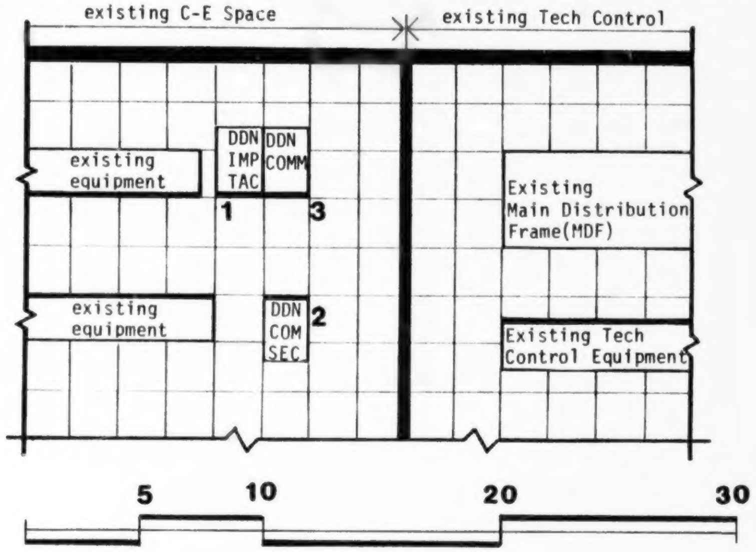


FIGURE DD-3. TYPICAL SELF-CONTAINED (SC) NODE OF DDN EQUIPMENT LAYOUT IN AN EXISTING DCS FACILITY (**1** = PROCESSOR CABINET, **2** = ENCRYPTION CABINET OR SAFE, **3** = COMMUNICATIONS CABINET.)

1. The SC-node layout in Figure DD-3 may not always be possible in existing DCS facilities if space for all three DDN cabinets is not available in one location. For a DDN I-node (integrated DDN equipment throughout the DCS facility), the cabinets may be separated. A typical example might be: cabinet 1 in the computer room, cabinet 3 in the Telco room, and cabinet 2 in the technical control.

The floor must be strong enough to support the system's weight. The weights of standard equipment configuration options, including the cabinet are:

Cabinet 1:	TEMPEST IMP & TAC.................	525 pounds
	2 - TEMPEST IMPS..................	650 pounds
	1 - TEMPEST IMP...................	450 pounds
	1 - TAC...........................	255 pounds
Cabinet 2:	1 - Encryption cabinet (max.).....	450 pounds
	or	
	1 - CRYPTO safe (max.)............ (for classified nodes)	1400 pounds
Cabinet 3:	Communications cabinet (max.).....	600 pounds

guidance

Outside dimensions of the equipment are:

Cabinets

Height: 80 inches
Width: 24 inches
Depth: 56 inches with rear door opened.

Safe

Height: 55 inches
Width: 22 inches
Depth: 65 inches with rear door opened.

To allow for services to the system, 36 inches on either side of the enclosure must be provided.

When a Service requires equipment cabinets to be secured to the floor, the mounts will be prepared during site preparation; it will be the requiring Service's responsibility to mount the cabinets on the prepared tiedowns.

Separation between equipment should be limited to:

Host computer to DDN IMP................................	2000 feet
Wideband trunk to DDN IMP..............................	50 feet
Wideband trunk to encryption cabinet....................	50 feet
TAC connections (local terminals, dial-in modems, limited distance modems and muxs)........................	50 feet
DDN IMP to encryption cabinet...........................	200 feet.

For classified nodes, the site must have the capability of terminating a 100-pair cable on an Intermediate Distribution Frame (IDF) convenient to the installation site, reserving the 100 pair back to the MDF Commercial Tie Point. If the MDF and Commercial Tie Point are in different locations, PMO and site personnel will decide, as part of the site survey process, what portion of the 100 pair is to be reserved for each location.

The 100-pair cable conforms to Western Electric D inside wiring cable 24-gage, solid, annealed bare copper conductor. Primary insulation should be rated for 144°F operations. Individual conductors are twisted into pairs with varying twist to minimize cross talk.

The outer jacket is flame-resistant. The cable should be cut off at the DDN communications cabinet with at least 15 feet of slack provided and should be terminated in standard Telco 50-pin connectors (AMP part no. 229941-1 or equivalent).

The cable should be run in available ductwork as close as possible to the communications cabinet. Shielded cable may be used to eliminate the requirement of running the cable in conduit up to the cabinet.

For unclassified nodes, the service shall provide and have installed to the above specifications a standard Telco 200-pair cable.

guidance

The site shall provide a telephone in a location where the site operations staff can clearly view the node equipment while holding a conversation. In classified nodes, telephone installation will be in accordance with NACSIM 5203 and other appropriate security manuals.

5. Raised floor system

Equipment that requires significant cooling to maintain communication operations should be located on a raised floor system for maximum use of coupled air directly through the cabinets. Cooling air at 60°F supplied directly into the transmitters' base will leave at the top at approximately 72°F. Air exiting the equipment is at a more comfortable temperature for personnel working in the space.

8. Equipment area

Fixtures should be arranged above the operating aisles and running parallel to equipment rows. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and is not obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RF interference filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23) 12 Portable task lighting should also be supplied for the equipment area at 70 to 100 footcandles.

9. Environmental controls

Operating spaces containing electronic equipment usually require close temperature and humidity control. Vapor barriers under floor slabs and incorporated into roofing usually can prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided when exterior walls form part of the equipment space. (92) 12.1-13

See Also SB2, Vol 2, Special Mechanical.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Lack of adequate cooling contributes as much to failure as does inadequately regulated power. (74) 4-17

Even though certain individual units may be operated outside the limits of the overall specifications, the system environmental regulations are dictated by the system's most restrictive unit. The computer system requirements are the major considerations in designing the air-conditioning system; however, good design also will consider personnel comfort. (74) 4-17

guidance

Heat dissipation for node equipment is:

	Equipment	BTU/hr	Watts
Cabinet 1	C/30 TEMPEST IMP	1400	411
	C/30 TAC	1400	411
Cabinet 2	TEMPEST IMP/TAC system	2800	821
	Encryption cabinet (max.)	855	250
	or		
Cabinet 3	CRYPTO safe (max.)	855	250
	Communications cabinet (max.)	3500	1026

Power and environment monitor

To maintain an acceptable environment for packet switches and NACs, a power and environment monitor (PEM) can be used at DDN sites. Each PEM contains multiple sensors, switch controls, and an asynchronous input/output port. Each PEM can monitor up to four collocated equipment racks and multiple UPS units. For each rack being monitored, the PEM supports sensors for open-door air flow in two locations, air-conditioner power, and temperature in three locations. In addition, each PEM supports two air-conditioner power sensors, two contact closure sensors, and a backup switch control for each UPS being monitored. Each PEM system has a data logger that sends alarms to a connected packet switch or mini-TAC whenever a sensor detects an important system status anomaly. The PEM also responds to DDN personnel requests for status information. This status information allows site personnel to monitor the environment in the equipment racks, thus helping to prevent hardware failure. (153) 43

10. Electrical

For classified nodes, power installation to the node area requires a dedicated circuit for each TEMPEST IMP/TAC cabinet, each communications cabinet, and each CRYPTO cabinet, all fed by separate circuit breakers. All power will be single-phase with a ground wire that runs back to the main circuit breaker panel without interruption. The branch circuit from the circuit breaker panel to the node area will be AWG-10/3 and run in EMT-type rigid or flexible electrical conduit using compression-type fittings and terminated in a 4-inch electrical junction box with a single NEMA-type L5-30R receptacle or equivalent, such as the Hubbell Inc. model #2610. The TEMPEST IMP/TAC must be connected to Red filtered power; the communications cabinet and encryption cabinet will be connected to Black filtered power. However, the Red and Black power must be from the same source to insure they are in phase. The Red power cannot come from one phase of a three-phase power source and the Black power from another phase of the same source.

Electrical junction boxes are to be located within 6 feet of the node equipment cabinets. At nodes where raised floors are installed and power cables are run under the floor, the junction box will be located under the floor. At other sites, junction box location should be identified during the site survey.

guidance

The green safety ground wire will be terminated at the main circuit breaker panel and must provide less than 10 ohms impedance to earth from d.c. to 10 megahertz. If the site has a station ground, a ground wire, AWG-10/3 or larger, will be run to the nearest station ground point, provided this point is within 15 feet of the node equipment and will provide less than 10 ohms impedance to earth from d.c. to 10 megahertz. No separate signal ground is required.

As part of the electrical site preparation, the service also should contain an emergency cut-off switch to disconnect power to the DDN equipment. This cut-off switch shall be located in the same room as the node, shall be installed in a way that will prevent accidental operation, and shall be accessible to operating personnel. Coverage of an existing emergency cut-off switch may be extended to DDN equipment at the Service's discretion.

Consideration should be given to providing a flexible system that will meet the facility's future requirements. Electronic equipment is constantly being upgraded, modified, and replaced. Bus duct systems and cable traps may prove to be the most flexible system in areas at which new equipment is expected or at which frequent modification may occur. (5) 3-4-8.

Power requirements for the different standard node configurations are:

Equipment	Voltage (a.c.)	Frequency	Amps	Phase
Cabinet 1 IMP/TAC combination	115 ± 10%	47 to 63 Hz	30	Single
Cabinet 2 Encryption cabinet	115 ± 10%	47 to 63 Hz	30	Single
Cabinet 3 Communications cabinet	115 ± 10%	47 to 63 Hz	30	Single

---

When required, node equipment can be provided for an input voltage of 220 volts a.c. ± 10 percent, and 50 hertz ± 2 percent (220-volt a.c. only).

Specifically refer to the "Electrical" portion of "Issues and Assumptions" portion of SB2, Vol. 2, for information relative to host nation power requirements. Additional information may be found in "guidance" of SB2 with respect to the standard frequencies and voltage levels used by various nations.

Provide host nation standard outlets of applicable.

guidance

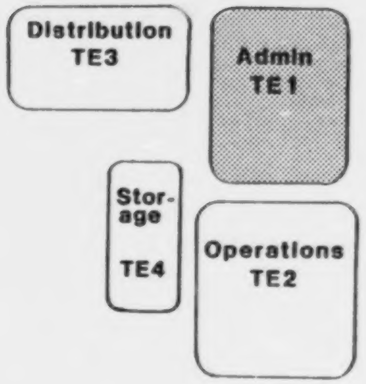
guidance

guidance

Distribution - Telecommunication Center [TE]

Telecommunication Center (TE)		TE-1
TE1	Administration	TE-2
TE2	Operations	TE-8
TE3	Distribution	TE-16
TE4	Storage	TE-22
TE5	Standardized Modules	TE-26

ADMINISTRATION TE1


Distribution
TE3
Admin
TE1
Stor-
age
TE4
Operations
TE2

function

To provide space that specifically supports the operations activity.

policy/sop

1. The traffic division officer establishes policy concerning message center operations and is responsible to the communications officer.

issues and assumptions

1. Enclosed office versus open area workstation

Noncommissioned officers in charge (NCOICs) and their assistants usually occupy an office workstation in the operations room itself. This makes their work more difficult, however, due to high noise and activity levels. If an enclosed office is provided, a view window to the console area must be installed.

activities

1. Distributing directives, orders, and policy statements, both written and verbal, to shift supervisors.
2. Planning exercises and contingencies.
3. Managing operations function.
4. Conferring with personnel (one-on-one).
5. Writing/typing reports.
6. Communicating operations and service functions.
7. Developing training plans.

personnel

1. Noncommissioned officer in charge.
2. Operations noncommissioned officer.

equipment *

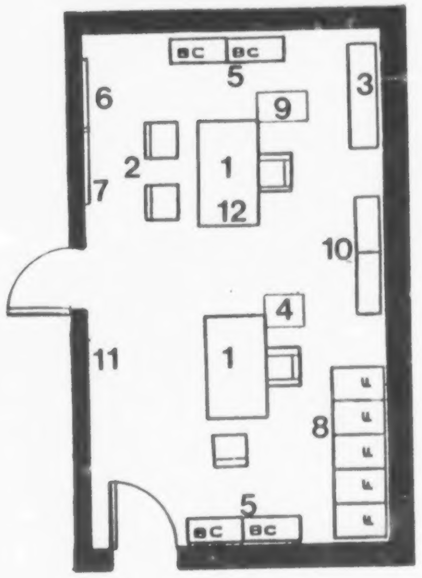
1. Desks with chairs.
2. Side chairs.
3. Credenza.
4. Typewriter with stand.
5. Bookshelves.
6. Tackboard.
7. Scheduling board (4 by 8 feet). Multiboard (4 by 8 feet).
8. File cabinet, five drawers.
9. CRT terminal.
10. Filesafe, five drawers.
11. Station log.
12. Telephone.
13. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

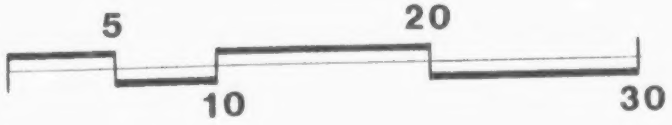
requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the administrative function.	**1.** Provide administrative space for two supervisory personnel with the required desks and chairs, bookcases, and file cabinets--approximately 400 square feet.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Carpet. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	**3.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**3.** See reference 201, page 3-4, Table 3-2.
4. Adequate lighting.	**4.** Provide 80 footcandles for task lighting at work surfaces with 40 footcandles for the ambient level. Surface reflectances should be: o Ceilings--80 to 90 percent o Walls--40 to 60 percent o Floor--20 to 40 percent.	**4.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for the occupant.	**5.** Maintain temperature at 68°F (heating), 78°F (cooling), with 5 cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	**5.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
6. Electrical power.	**6.** Provide 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunicator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

requirements	criteria	commentary
10. Visual contact from the offices to the operations floor to provide management with better opportunities to optimize personnel effectiveness.	**10.** Administrative office space should be provided adjacent to the operations center console.	
11. Communications lines (outside/inside) for emergency operations and for interaction between offices and operations floor.	**11.** Coordinate telephone and intercom needs with the installation.	

guidance



13-- speaker in ceiling



guidance

1. Location

Windows to the outside are recommended for CONUS facilities on secure sites, such as military installations. OCONUS facilities usually should have a minimum of windows to limit opportunities for forced entry.

3. Acoustical and visual privacy

Divider partitions between workstations should be 60 inches high (± 4 inches) to provide visual privacy while occupants are seated--and yet should not be confining. Circulation paths around workstations should minimize disturbances to other workstations.

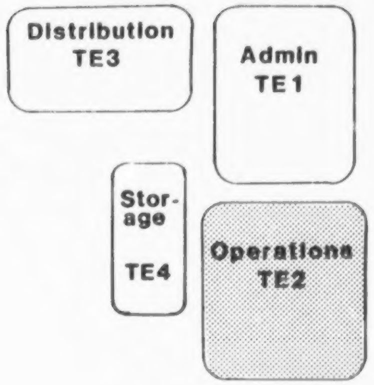
6. Electrical power

Workstation divider partitions can be tackboard surfaces to display maps, job examples, service equipment, and other information. Floor-to-ceiling poles are recommended to distribute electrical and communication lines to workstation modules. This eliminates floor wires at circulation paths and allows future module modifications at minimal cost.

guidance

guidance

OPERATIONS TE2


Distribution TE3
Admin TE1
Stor-age TE4
Operations TE2

function

To provide message processing and manual tape relay to specified units or customers.

policy/sop

1. Operations require 24-hour-per-day staffing with four daily shifts.

issues and assumptions

1. DSSCS versus GENSER message distributions

Y-type messages (Defense Special Security Communication System, DSSCS) require a secure area for processing. Thus, the receiving clerk who processes Y traffic must do so in the secure operations room rather than taking such messages into a nonsecure distribution room. R-type messages (General Service, GENSER) are distributed from nonsecure areas.

activities

1. Transmitting, receiving, and processing messages.
2. Typing report logs.
3. Training personnel.

personnel

1. Shift supervisor.
2. Two operators.

equipment *

1. Communication equipment (see Guidance for list of typical layout).
2. One desk/workstation with chair.
3. Four files.
4. Telephones.
5. Intercom speaker.

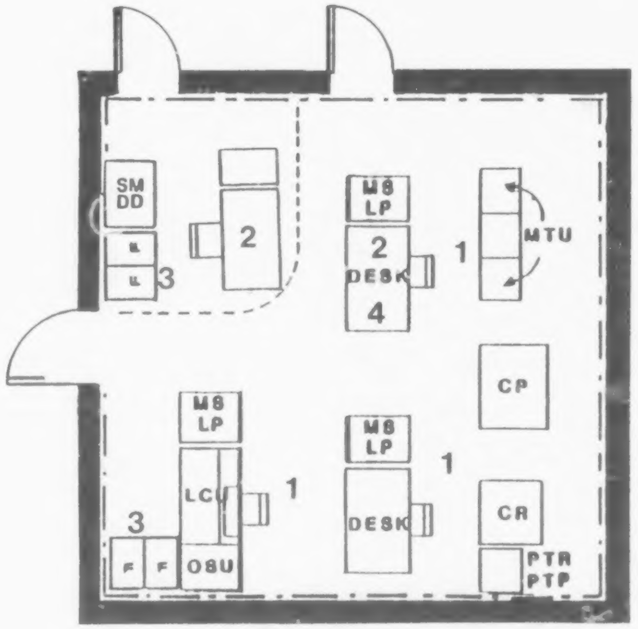
* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Adequate space for the operation and monitoring of communications-electronics (C-E) equipment. Spatial requirements must allow for proper spacing between equipment to facilitate easy maintenance.	**1.** Message center sizes vary due to extent of equipment required. See layouts in Guidance for various sizes.	
2. A secure environment for C-E equipment.	**2.** The operations room must be lockable when unstaffed and must be supplied with an intrusion alarm system. The operations console should be fitted with alarms for intrusion, power failure, and generator status. Covers should be provided on overhead rods for rapid sanitizing of applicable equipment.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Signal shielding.	**3.** See Vol 2, SB4--Grounding, Bonding and Shielding along with SB7--Security Systems for more information.	
4. EMP/HEMP shielding.	**4.** Shielding is necessary for survivability and uninterrupted functioning when the facility is subjected to EM pulse (EMP) and high-altitude EM pulse (HEMP). Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	**4.** See Vol 2, SB5, EMP/HEMP Protection, for more information.
5. Raised floor system.	**5.** Raised or false floors are necessary for proper cooling of the equipment.	**5.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
6. Interior finishes suitable for durability, maintenance, and room function.	**6.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor with a dust-on finish that contains a hardener. See Vol 2, SB2--Interior Construction. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Wall--Paint over concrete, gypsum board, or plaster and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	**6.** See also Vol 2, SB2, Interior Construction and Finishes.
7. Acoustical isolation attenuation for variable noise levels produced by electronic equipment.	**7.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile is also required to within 4 feet of the floor.	

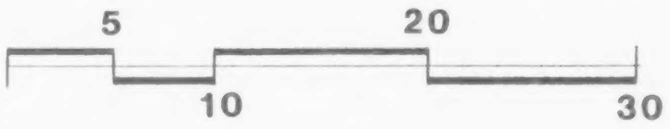
requirements	criteria	commentary
8. Adequate lighting.	**8.** Lighting shall be specially engineered. Low levels of lighting may be required to permit observation of luminous panels without reflected glare or undesirable contrasts in brightness. Separately controlled luminaires shall be provided for normally lighted operations and for cleaning, with an ambient level of 70 footcandles from fluorescent fixtures.	**8.** For further information on quality lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
9. Controlled environment for proper operation.	**9.** Maintain 70°F (±2°) and 50 percent relative humidity (± 5 percent continuously. Provide 5 cubic feet per minute per person outside air ventilation rate or the outside air quantity necessary to maintain a room pressurization requirement of .05 to .10 water gage.	**9.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
10. Electrical power.	**10.** Provide 120/128 electrical service and 120-volt outlets--one receptacle for every 10 linear feet of wall. Outlets for equipment should be available under the raised floor as per layout. Electrical power must fall within the 10,000 to 500,000 watt range, with frequency levels at 50 to 60 hertz ± 5 percent.	**10.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**11.** Vaulted enclosure walls--2 hour (minimum) fire-rated, shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area--Automatic fire detection: Local alarm. Automatic Halon 1301 suppression system if required for cross-zoned or matrix detection. Sprinkler and Halon systems are not normally installed in the same areas.	**11.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

requirements	criteria	commentary
12. Supervisor's visual contact with message communication equipment.	**12.** Supervisor's desk should be located at the center, between the operations space and the distribution area. To review the distribution area, see TE-3.	
13. Communication lines (inside/outside) for emergency operations and internal interaction between offices and the operations space.	**13.** Coordinate telephone and intercom needs with the installation.	

guidance



5-- speaker in ceiling



guidance

1. Equipment expansion

It is advisable to arrange equipment in the equipment room such that future expansion of the building will not necessitate complete rearrangement. (2) 5-21

Approximately 3 feet of clearance space, as a minimum, should be allowed in front of and to the rear of an equipment bay. If a bay does not permit rear access to equipment, the bay can be installed with no clearance on the back side, that is, against a wall or back-to-back with other bays, unless ventilation requirements are compromised. (2) 5-21

5. Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on raised floors for maximal use of coupled air directly through the cabinets. Cooling air at 60°F supplied directly into the base of the transmitters will leave the top at approximately 72°F. Thus, when the air exits the equipment, it is at a more comfortable temperature for persons working in the space.

8. Control area

Light fixtures should provide an approximate uniform lighting intensity of 70 footcandles and should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. Lights over the area in which the control console is located shall be provided with wide-range (100:1) dimming control. (23)12

Equipment area

Fixtures should be arranged above the operating aisles and should run parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so light is not obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23)12 Portable task lighting should also be supplied for the equipment area at 70 to 100 footcandles.

9. Protection from moisture migration

Operating spaces that contain electronic equipment usually require close temperature and humidity control. Vapor barriers placed under floor slabs and roofing usually prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided if exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

guidance

Mechanical

The recommended operating temperatures and humidity conditions should be obtained from the manufacturers of the communications and data processing equipment and should be used in designing the environmental control system.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Inadequate cooling contributes as much to failure as poorly regulated power. (74) 4-17

Even though certain individual units can operate outside the limits of the overall specifications, overall environmental requirements are dictated by the most restrictive unit of the system. The computer system's requirements are the major considerations; however, good design will also consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in the following ways. (74) 4-17

- Heat dissipation by computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The number of air changes per hour varies between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Also, if the air-conditioning requirements are not met, a record must be available to indicate the extent and duration of the undesirable condition and indicate whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-25

guidance

- Insure the air-conditioning system continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is needed when humidity limitations are exceeded. Drying out may be necessary if the excess humidity occurs either during periods of actual operation or while the machine is shut down and unattended. The extent and duration of excessive humidity determines the length of the drying-out period.
- Determine if the environment meets requirements for the machine.

A visual or audible signaling device is desirable in the recording instrument. This is to provide visual or audible indication that temperature or humidity in the computer area is nearing the maximum limit.

Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The recorder is usually located at a representative spot in the room and adjacent to the control devices.

For monitoring underfloor air conditions, a remote indicating instrument is recommended. This is usually a 7-day electric-drive chart and can be the wet-and-dry-bulb or electronic type if direct reading is not available. The recording instrument can be located on the wall in the operations room, in the mechanical equipment room, or in any other location convenient to the building engineer.

10. Electrical

Consider providing a flexible system that will meet the facility's future requirements. Electronic equipment is constantly being upgraded, modified, and replaced. Bus duct systems and cable trays may prove to be most flexible for areas in which new equipment is expected or that may have frequent modification. (5) 3-4-8

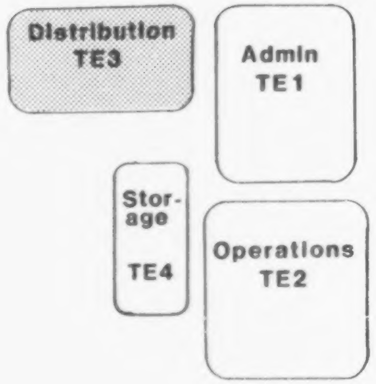
Specifically refer to the "Electrical" portion of "Issues and Assumptions" portion of SB2, Vol. 2, for information relative to host nation power requirements. Additional information may be found in "guidance" of SB2 with respect to the standard frequencies and voltage levels used by various nations.

Provide host nation standard outlets if applicable.

guidance

guidance

DISTRIBUTION TE3


Distribution
TE3
Admin
TE1
Stor-
age
TE4
Operations
TE2

function

To provide over-the-counter message pickup service.

policy/sop

1. Operates as the pickup point for the 24-hour per day distribution of communication messages to local customers. Handles all written communication forms--writing, transmitting, and receiving.

issues and assumptions

activities

1. Reproducing and distributing message traffic or information of vital concern.

personnel

1. Xerox operator.
2. Distribution clerk (depends on size of operation).

equipment *

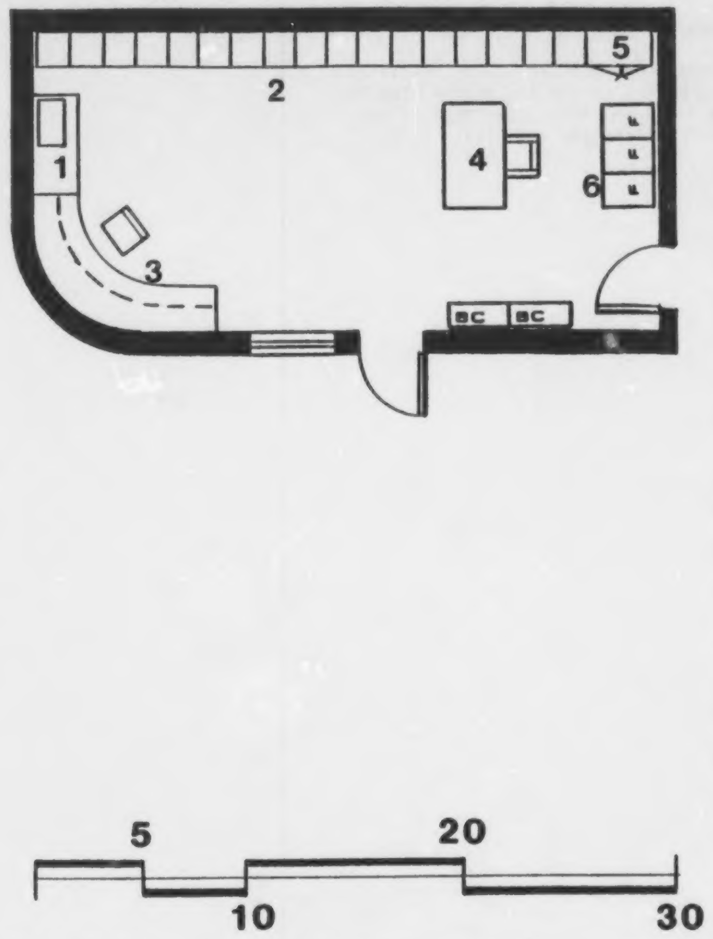
1. Xerox copier.
2. Distribution boxes.
3. Message pickup and authorization counter.
4. Desk with chair.
5. Supply cabinets.
6. Three files.
7. Customer card file.
8. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate IDS equipment and personnel associated with security component.	**1.** Space needs vary due to the extent of equipment required to handle the traffic volume. Provide approximately 600 square feet for the pick-up entry and the message distribution room.	
2. Visual verification of entering personnel.	**2.** Provide a pass window.	
3. Communication and electronic monitoring lines.	**3.** Coordinate IDS components into a centralized module. Provide an annunciator panel with telephone and intercom link-ups. The operation room console should have remote alarms along with a CCTV monitor.	
4. Resistance against penetration from the outside and for the armory.	**4.** Windows should be glazed and hardened to prevent penetration (bullet-proof glass). Windows also should be designed for full visibility over approaches to the point of entry.	**4.** See Vol 2, SB7, Security (Zone 3), for more information.
5. Interior finishes suitable for durability, maintenance, and room function.	**5.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**5.** See also Vol 2, SB2, Interior Construction and Finishes.
6. Acoustical isolation and attenuation for a nondisruptive environment.	**6.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	
7. Adequate lighting to review entering personnel and monitoring equipment.	**7.** Lighting shall be specially engineered. Low levels of lighting may be required to permit observation of luminous panels without reflected glare or undesirable contrasts in brightness. Separately controlled luminaires shall be provided for normally lighted operations and clean-up; this lighting should have an ambient level of 70 footcandles using fluorescent fixtures.	**7.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical Lighting.
8. Thermal regulation and other comfort features for the occupant.	**8.** Maintain temperature at 68°F (heating) or 78°F (cooling) with a 5 cubic feet per minute per person outside air ventilation rate. A dehumidifier may be required in the armory. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	**8.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
9. Electrical power.	**9.** Provide 120/128 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and for every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	**9.** See also Vol 2, SB2, Communication Station Buildings--Electrical.

requirements	criteria	commentary
10. Fire protection/life safety criteria are based on the assumption that this facility houses critical equipment and data that has a severe strategic fire loss potential.	**10.** Interior enclosure walls--2-hour fire-rated construction in armory, security, and entry. Interior doors--1.5-hour fire-rated doors in armory, security, and entry. Interior finish--Class A or B only. Corridor and entry finish--Class A only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**10.** See Standardized Modules-Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety for more information.

guidance



guidance

1. Location

The minimum area is determined from IDS monitoring equipment physical dimensions.

Direct access to facility entrance is required.

This area must have no direct access to C-E equipment.

This component can be combined with the administration function in the small module package.

2. Verification

Orient windows to allow visual security of arriving personnel. In some circumstances, it works well to use mirrors to show the total front face of the building before the door is opened. This also prevents the security officer from confronting unexpected hostile action when leaving.

3. Monitoring

Three shifts in a 24-hour period are assigned for these activities if the personnel are available. At some smaller facilities, the security alarm and detection devices should also be wired into the operations, operations administration, or control monitoring space so that operation shift personnel can monitor the security system when the security space is not staffed.

Alarm system--Provide a wall-mounted alarm terminal panel in the security room. The following alarms will terminate there:

- Smoke/fire detection
- Intrusion detection of all doors and barred openings.

The termination board or its associated housing should have all alarm terminations identified clearly with permanent marking or labels. This allows future extensions of these connections to a control and fault alarm system. The alarm sensors should incorporate only dry contacts (no voltages) and should use two conductor shielded cables in the circuit runs (or in conduit) to the consolidated terminal panel noted above.

Intrusion detection system--The IDS should conform to Corps of Engineers Guide Specification CE 304.01. Provide magnetic intrusion alarm switches on all exterior doors and openings greater than 7.6 feet at the perimeter into the building. Terminate all circuits in the wall-mounted alarm panel. The door alarm is to sound then the door moves 1/2 inch toward an open direction.

best copy available

guidance

The various approaches to an alarm display problem offer a wide range of capabilities, but also present several distinct disadvantages. In selecting an alarm display system for a specific installation, it is essential that the features and capabilities required for the intended application be well understood. In particular, there is no one "best" system for transmission and display of security information. Rather, a system should be selected to meet the needs of the specific installation. It should also be noted that many systems may provide more capability than is needed or desired and that paying for unused features would tend to increase the system's cost. See Vol 2, SB7, Security Systems, for more information.

4. Primary entrance door

The primary personnel entrance door should be secured with a jimmy-proof, deadbolt extension operated by a combination lock in conformance with UL Standard 768 and Military Specification MIL-L-15596. The primary entrance door should also be equipped with panic bolts and a rim with a box mullion in conformance with Federal Specification FF-H-106. The panic bolts should be UL-approved. If required for routine access control, an electrically controlled latch mechanism is authorized for installation. RF emissions should meet the requirements of MIL-STD-461 of Class II-A equipment when applicable. (5) 3-5-9

The personnel entry doors should be the steel, single-swing type with a steel frame. Another option is a door constructed of hollow metal with a 1/8-inch steel plate face.

Personnel entry doors should also be equipped with a "peephole" wide angle lens. Doors should have an inside plate to cover the peephole when it is not in use.

Hinges on both the exterior personnel and equipment doors must be welded to prevent removal of hinge pins if pivots and pins are on the outside.

7. Lighting design

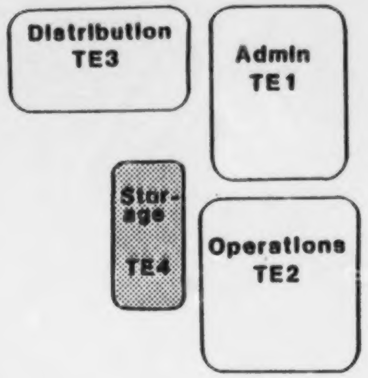
To reduce glare at video digital terminals (VDTs), use fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values.

The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On tall ceilings, the cell depth must be greater; this may dictate a larger cell size.

Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting is also recommended for its noise control and virtual elimination of reflections.

guidance

STORAGE TE4



Distribution TE3
Admin TE1
Stor-age TE4
Operations TE2

function

This area is for the temporary placement of miscellaneous items and nontechnical equipment.

policy/sop

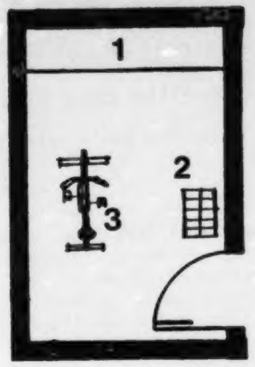
1. All services have physical fitness requirements that must be met. For remote DCS facilities that have no installation services available, it is recommended that exercise equipment be made available. The exacting, sometimes intense, activities of maintaining and controlling the DCS require periodic breaks for physical exercises.

issues and assumptions	activities	personnel	equipment *
1. Storage for exercise equipment The exercise equipment should not conflict with the function of other personnel-oriented rooms. A general purpose storage room is suitable since the equipment is unofficial.	1. Shelving of miscellaneous sized items.		**1.** Shelving 18 inches deep.
	2. Individual exercise.		**2.** Small step ladder.
			3. Exercycle, universal gym, and/or loose weights.

* see "guidance" box for example layout of all equipment listed.

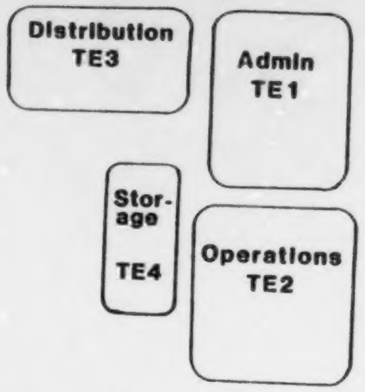
requirements	criteria	commentary
1. Enough space to accommodate two or three persons exercising, plus space to move about for shelving items.	1. Allow approximately 250 square feet to accommodate the exercise equipment plus 60 linear feet of shelf space.	
2. Interior finishes suitable for durability, maintenance, and room function.	2. Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	2. See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	3. Adjacent room walls should limit sound transmission to 40 decibels.	
4. Adequate lighting.	4. Use 30-footcandle (ambient) fluorescent fixtures.	
5. Thermal comfort.	5. Regulate temperature at 68°F (heating), 78°F (cooling). Provide 10 cubic feet per minute per person outside air ventilation rate with on-off switching.	5. See also Vol 2, SB2, Communication Station Buildings--Mechanical.
6. Electrical power.	6. Install 120/208 electrical service. Provide 120-volt outlets--one receptacle for every 10 linear feet of wall. Frequency levels should be at 50 to 60 hertz ± 5 percent.	6. See also Vol 2, SB2, Communication Station Buildings--Electrical.
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	7. Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	7. See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



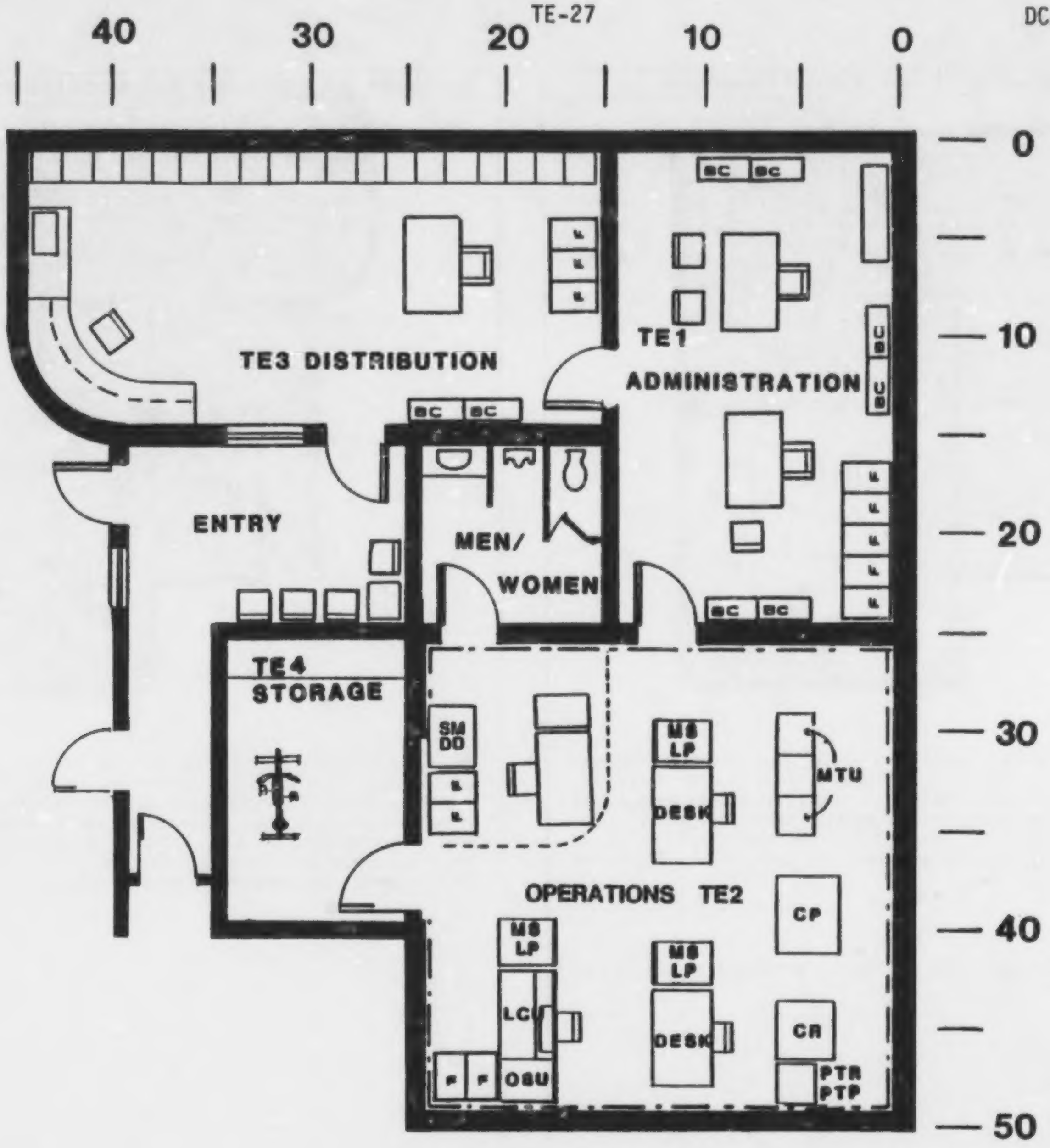
guidance

STANDARDIZED MODULES TE 5



building design principles

1. Efficiency of operational functions
    - a. Communication equipment aligned for surveillance and access.
    - b. On-the-job training with operating equipment.
    - c. Interaction of operational support activities.
2. Efficiency and accessibility of administration spaces
    - a. Administration transition space between public areas and secure spaces.
    - b. Efficiency of integrated administrative spaces.
3. Fire protection
    - a. Fire protection classifications: occupancy, hazard of contents, sprinkler protection, and construction/materials.
    - b. Building separation distances.
    - c. Fire protection systems: automatic fire suppression, automatic notification/alarm, and automatic fire detection.
4. Life safety
    - a. Occupant load determination.
    - b. Protected exit conditions: exit capacities, number of exits, exit travel distances, and means of exit arrangement.
    - c. Allowable interior finishes.
    - d. Egress path identification: illumination of means of egress, emergency lighting, and means of egress marking.


40
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40
50
TE3 DISTRIBUTION
SC
SC
TE1
ADMINISTRATION
SC
SC
SC
SC
SC
SC
ENTRY
MEN/
WOMEN
TE4
STORAGE
SM
DD
MS
LP
DESK
MTU
OPERATIONS TE2
CP
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LC
DESK
CR
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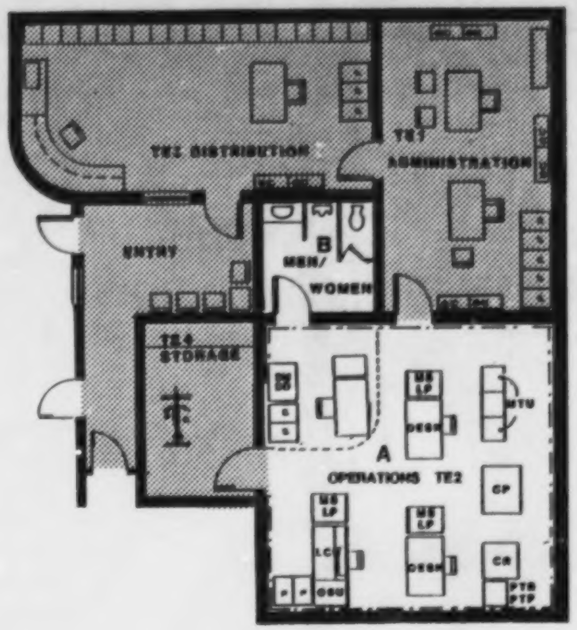
OSU
PTR
PTP

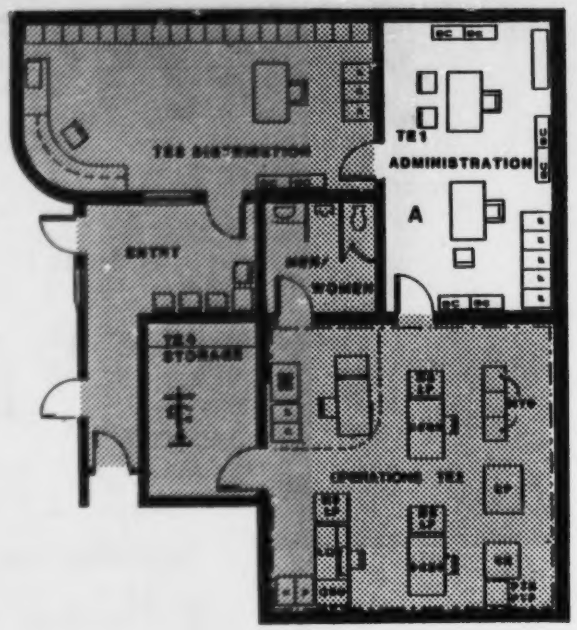
guidance 1. Efficiency of Operational Functions


TE3 DISTRIBUTION
TE1
ADMINISTRATION
ENTRY
B
MEN/
WOMEN
TE4
STORAGE
MB
LP
DESK
MTU
A
OPERATIONS TE2
CP
LCT
CR
OSU
PTR
PTP

A Equipment should be aligned in parallel rows within the operations modules for ease in visual surveillance and to provide direct access to all critical equipment. Multiple consoles should be adjacent to each other so that limited personnel can monitor them efficiently at one central location. Tables for audiovisual training aids should be available in operations modules so that personnel can train on-the-job during regular watch periods.

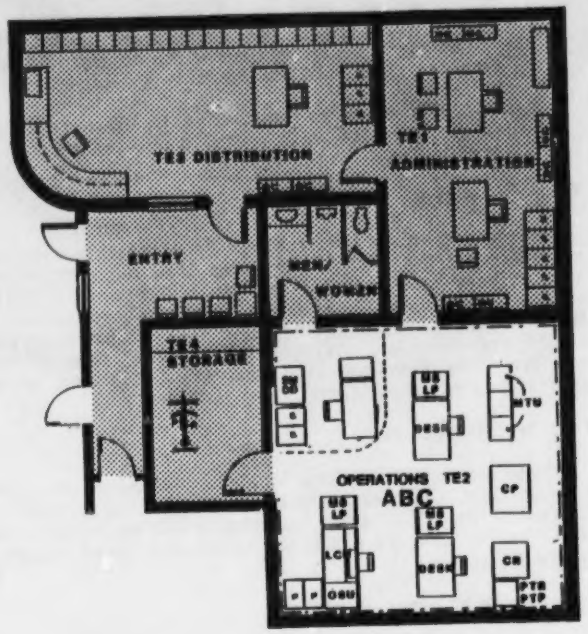
B Toilet facilities should be nearby for personnel in the operations module.

guidance 2. Efficiency and Accessibility of Admin. Spaces


TE3 DISTRIBUTION
TE1
ADMINISTRATION
A
SC
ENTRY
MEN/
WOMEN
TE4
STORAGE
OPERATIONS TE2
CP
CR

A Administration modules must be easily accessible to the public to minimize circulation and to prevent visitor interference with facility operations. The administration modules should provide a buffer and transition space between the exterior and interior secure spaces. Also, public corridors in the administration area should contain military unit logos and other display panels that relate to the "esprit de corps" and unit integrity of the communication station.

guidance **3. Fire Protection**



Occupancy classifications: Business (NFPA); B-2 (UBC)

Hazard of contents classification: Ordinary hazard

Sprinkler protection classification: Ordinary hazard--group 2.

Construction classifications/materials for fire protection (See Vol 2, the first figure in SB3, Fire Protection/Life Safety)

A Type II--One-Hour (UBC) for battery, cryptography (RED/BLACK),* custodian, generator, operations,* mechanical, and transmission spaces:

All construction elements.......1-hour rated construction

Type II--N (UBC) for remainder of building spaces

All construction elements.......Noncombustible construction

Building Separation

Site-specific information is required. Comply with the second figure in Vol 2, SB3, Fire Protection/Life Safety.

Interior finishes

See Guidance/Life Safety, Vol 2.

Fire protection systems

Automatic fire suppression

A water sprinkler system shall be provided throughout the entire facility.

Automatic notification/alarm

A general alarm must be activated by the automatic sprinkler system.

B Local alarms are required to sound only in the designated spaces; they are activated by smoke detectors.

Automatic fire detection

C Smoke detectors are required to activate local alarms only in the designated spaces. In rooms containing raised floor areas, smoke detectors shall be located under the raised floor.

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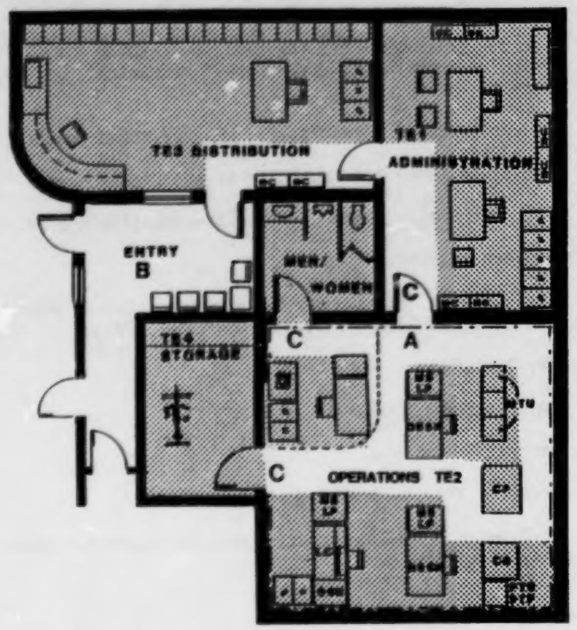
*See Vol 2, SB7, Security, for vault construction requirements that may be more stringent than those imposed by fire protection requirements.



OCCUPANT LOAD FOR DETERMINEING EXIT REQUIREMENTS.

Occupant load factor: 100 square feet per person based on gross floor area (Business Occupancy-NFPA)

Occupant load (total facility) $= \frac{1925 \text{ sq ft}}{100} =$ 19 persons

Occupant load (vaulted area) $= \frac{625 \text{ sq ft}}{100} =$ 6 persons

Occupant load (admin/support) $= \frac{840 \text{ sq ft}}{100} =$ 8 persons

Exit capacities

Corridors--100 persons per unit of exit width for travel in either direction. The minimum width of any exit access corridor or passageway shall be 44 inches in the clear.

Doors--100 persons per unit of exit width (a 3-foot door provides 1.5 units of exit width, providing an exit capacity for 150 persons).

Number of exits

No less than two exits shall be accessible from every part of every floor. One exit is permitted when the room or area has: (1) a total occupant load of less than 100 persons, (2) direct exit to an open area outside the building at the ground level, and (3) a total travel distance on the same level of not over 100 feet. (If stairs are involved, they shall be no more than 15 feet in height and shall be provided with complete enclosures to separate the stairs from any other part of the building.)

Exit travel distances

Required exits shall be located to allow access without passage through areas that may be locked. No dead end corridor shall exceed 50 feet. Travel distance to exits shall be no more than 300 feet when the building is protected throughout by an approved automatic sprinkler system.

Arrangement of means of egress

Exit access and travel routes to exits are shown in the plan.

A Exit doors in vaulted areas that contain communications equipment are secured and permit egress out only. Exit access routes through vaulted areas from spaces outside the vaulted area are not permitted for security reasons.

Interior finishes

B Interior finish in exit access corridors shall be Class A only.

Interior finish in the remainder of the building shall be Class A or B only.

Means of egress lighting

Exits and exit access, including stairs, aisles, corridors, and passageways leading to an exit, shall be lighted continuously during times when the conditions of occupancy require means of egress to be available. Lighting should be no less than 1 footcandle measured at the floor.

Emergency lighting

Emergency lighting shall be provided in windowless buildings for designated aisles, corridors, and passageways leading to an exit. Emergency lighting shall stay at least 1 footcandle throughout the means of egress for 1.5 hours in the event of normal lighting failure.

Marking the means of egress

Exits shall be marked by an approved sign readily visible from any direction of exit access. Signs shall be placed such that no point in the exit access is more than 100 feet from the nearest visible sign.

C Doors located or arranged so that they are likely to be mistaken for exits shall be identified by a sign reading "NOT AN EXIT."

guidance

CONTROL FACILITY MODULES

System control for military communications is in a transitional stage. Almost by necessity, system control development has been reactive, responding to changes in the traditional communications functions--transmission and switching. These two communications functions are evolving rapidly toward digital and highly automated operations. As a result, some aspects of system control--notably the lower levels in the hierarchy, i.e., the functions associated with technical control--may never catch up to switching and transmission advances, or they may become absorbed into other functional areas. For example, in a digital hierarchy, first-level multiplexing soon may be performed at the switch, eliminating the need for traditional technical control patching. Digital transmission systems similarly could make technical control equalizers and conditioning equipment obsolete. At the higher levels of control (that of large networks as opposed to single links) the proliferation of small, powerful computing capabilities may require revolutionary developments in control concepts. Distributed processing and control are fast becoming technical realities.

The constraints on system control also are influenced heavily by the nontechnical issues; that is, where and how a given system is controlled are dictated by who controls it. Thus, policy, roles, missions, and corporate/military domination in particular areas dictate control methods and techniques. Although this situation is normal, the technical realities premising the early formation of such policies, roles, and missions are changing rapidly.

The trend in system control now reflects advances in the areas of link control and automated and remote analysis. This technology, which originated in private industry, is directly transferrable to military network control.

Vendor-Supplied Link Control Packages

Besides controlling errors and message sequencing, link control monitors line quality, equalizes the carrier, and effects recovery when failure is detected. Several vendors offer automated techniques for handling all of these control functions. Some companies offer line monitoring through use of software-controlled hardware and through summary statistics of line performance based on data received. Vendors also offer the capability for automatically reconfiguring the network when line failure is detected. This is effected by software-controlled switching of the hardware controlling backup or redundant lines, or by providing enough intelligent routing algorithms that calculate alternative routes when network links are eliminated. (182) B-41

Automated Line Analysis Tools

A variety of data-line monitors, protocol analyzers/simulators, and similar equipment can be either added to existing communications networks or designed into planned networks to complement planned vendor-assisted control packages. Breakout boxes are used for troubleshooting and identifying interface and timing incompatibilities. These boxes connect the data terminal equipment (DTE) to the data communications equipment (DCE). The breakout box can determine the status of each lead between the two elements.

Error rate testers monitor the data returned to them, usually through a loopback. The two most common devices in this group are Bit Error Rate Testers (BERT) and Block Error Rate Testers (BLERT). These testers cover the whole transmission facility and the hardware and give a reasonable indication of whether the problem is random, continuous, or periodical, occurring in bursts.

Data-line monitors bridge the connection between the DTE and the DCE on a noninterfering basis. They display data and events as the two units interact. Often they are equipped with trap units that allow only the events of interest to be displayed for analysis.

Simulators contain all the abilities of the data-line monitor, but also can emulate a DTE or DCE offline for interactively testing a suspicious component.

Network control systems are the most complete of all systems available in the telecommunications/data communications test field. They can control and monitor hundreds of communications lines. Each network point carries its own address which is checked periodically for proper operation. Conditions checked include terminal failure, modem failure, line degradation, signal quality, transmit levels, and receive levels. (182) B-42

Equipment System Control

The increasing complexity of networks due to the greater number and type of lines and equipment, coupled with the decreased cost of hardware, has resulted in the development of automated patch panels. Most major vendors offer at least the capability to control switching between equipment connected to the host machine that receives data from the communications line. Several other vendors have much more elaborate systems, such as those using a switching matrix. These systems are controlled by an operator at a console connected to the host computer and allow dynamic reconfiguration of the network. In situations for which backup computers are used to increase reliability, the switching system can provide for automatic cutover to spare equipment racks when failures are detected in the principal equipment. Stored programs in the microprocessor-controlled switch can switch groups of lines between computers with a single command, can prohibit certain switching patterns, and can be set up to carry out series of complex switching and patching operations with a single operator command. Other features available include automatic, software-controlled loopbacks, line utilization reports, data compression, automatic baud recognition, and bandsplitting.

From the user's viewpoint, the intelligent patch panel offers a simple interface for providing feedback on the entire network and, at the same time, conserves computer resources and affords maximal flexibility. An intelligent patch panel also can be used as a control tool to monitor and modify an entire network through four main methods: universal access, contention and user feedback, statistics, and dynamic console control.

Universal access allows all users to focus on a single interfacing device for all connection techniques and speeds. The hard-wired local terminal, using just three connections, can tie in with the same resources as the dial-up and multiplexed user. From the computer-site manager's viewpoint, universal access means a user can select the most cost-effective connection technique, regardless of terminal type and interface differences. Contention and user feedback frees the computer site from the user complaints that typically lead to pilot errors by overburdening an undertrained computer-system staff.

Monitoring statistics on the entire network is the key in effectively using both computer and communications resources by pinpointing over- and underuse of each network component, especially in multiple-computer environments. Also, listing such events as connection failures, busy-queue size, and unauthorized entry spotlights trouble areas.

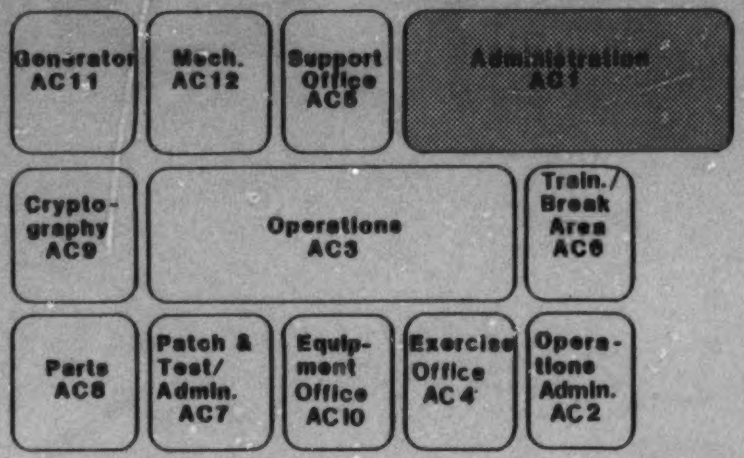
Dynamic console control is another important feature of the intelligent patch panel. When problems occur in allocating and controlling resources, dynamic network reconfiguration allows an immediate remedy and, in some cases, experimentation to determine the best possible resource mix.

With console control, the user can adjust to heavy-load periods by reassigning resources and enlarging busy queues, much as power companies do in load sharing. The timeout feature can help identify idle users, who, when spotted, are disconnected by the intelligent patch panel from access to the computers. In sensitive or secure environments, the unauthorized message flags a user who tries to improperly access a restricted resource, and the resulting access data may help identify reckless or harmful users. (182) B-43

Area Communication Operation Center [AC]

Area	Communication Operation Center (AC)	AC-1
AC1	Administration	AC-2
AC2	Operations Administration	AC-6
AC3	Operations	AC-12
AC4	Exercise Office	AC-18
AC5	Support Office	AC-22
AC6	Training/Break Area	AC-26
AC7	Patch and Test/Maintenance	AC-30
AC8	Parts	AC-36
AC9	Cryptography	AC-40
AC10	Equipment	AC-46
AC11	Generator	AC-52
AC12	Mechanical	AC-58
AC13	Standardized Modules	AC-62

ADMINISTRATION AC1


Generator AC11
Mech. AC12
Support Office AC5
Administration AC1
Cryptography AC9
Operations AC3
Train./Break Area AC6
Parts AC8
Patch & Test/ Admin. AC7
Equipment Office AC10
Exercise Office AC4
Operations Admin. AC2

function

To establish and maintain the station administrative processing of personnel records. To implement written and verbal SOP directives from chain of command orders, host agency regulations, and DCA policy for the DCS. To provide a buffer and transition space between exterior and secure interior spaces.

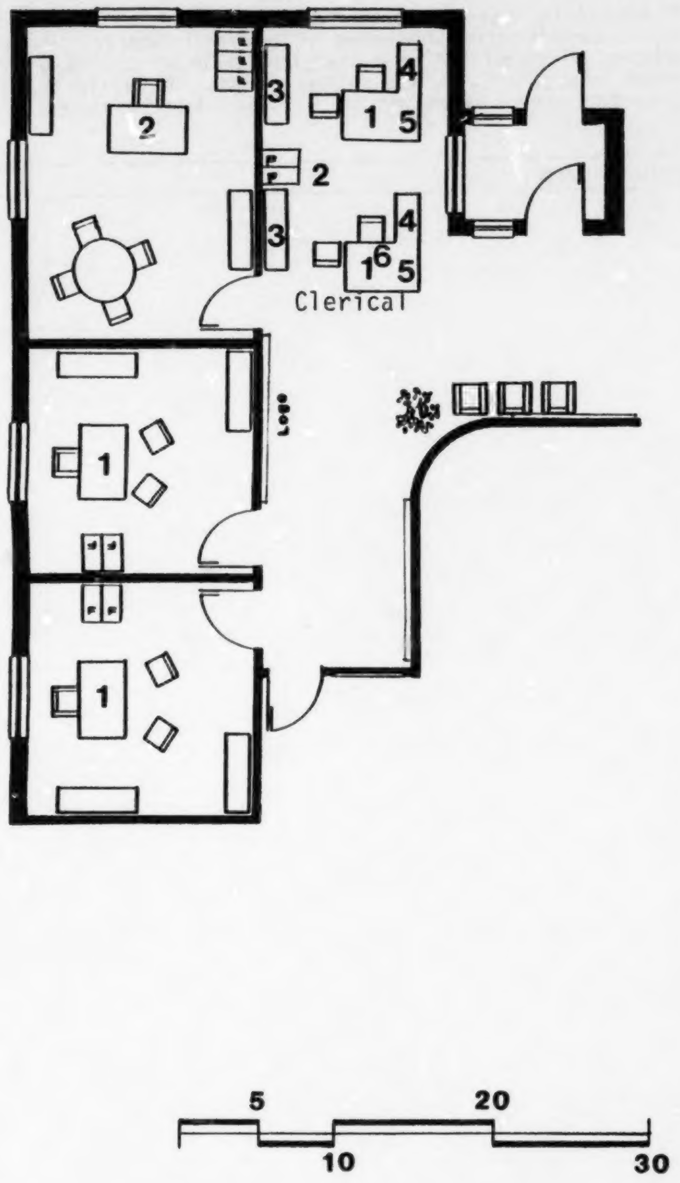
policy/sop

issues and assumptions	activities	personnel	equipment *
	1. Distributing directives, orders, and policy statements both written and verbal, to shift supervisors. 2. Initiating evaluations of equipment capabilities for expansion of system communication service to customers.	1. Division chief. 2. Operations officer in charge (OIC). 3. Support OIC.	1. OIC's workstation, dual support OIC desk/chair (enclosed), two side chairs. Bookshelves--20 linear feet. 2. Two files, five drawers each. Division chief's desk with chair, side chair, bookshelves--20 linear feet. Three files, five drawers each.
	1. Typing, receiving, and coordinating command/control process for NCOIC. 2. Filing and posting operations and personnel documents. 3. Providing a courier service for paperwork.	1. Two secretaries.	1. Clerk workstation: desk with typing return and chair (open area). 2. File--four drawers. 3. Bookshelves--45 linear feet. 4. Typewriters/word processor(s). 5. Telephone. 6. Operational voice intercom control.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the administrative function.	**1.** Provide enclosed offices from 150 to 300 square feet. Open-area workstations should provide 100 square feet per person.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Carpet. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	**3.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**3.** See reference 201, page 3-4, Table 3-2.
4. Adequate lighting.	**4.** Provide 80 footcandles for task lighting at work surfaces with 40 footcandles for the ambient level. Surface reflectances should be: • Ceilings--80 to 90 percent • Walls--40 to 60 percent • Floor--20 to 40 percent.	**4.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for the occupant.	**5.** Maintain temperature at 68°F (heating), 78°F (cooling), with 5 cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	
6. Electrical power.	**6.** Provide 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppresion--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunicator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location

Windows to the outside are recommended for CONUS facilities on secure sites, such as military installations. OCONUS facilities usually should have a minimum of windows to limit opportunities for forced entry.

Activity subspaces

- Enclosed offices
- Workstations
- Filing area
- Reception.

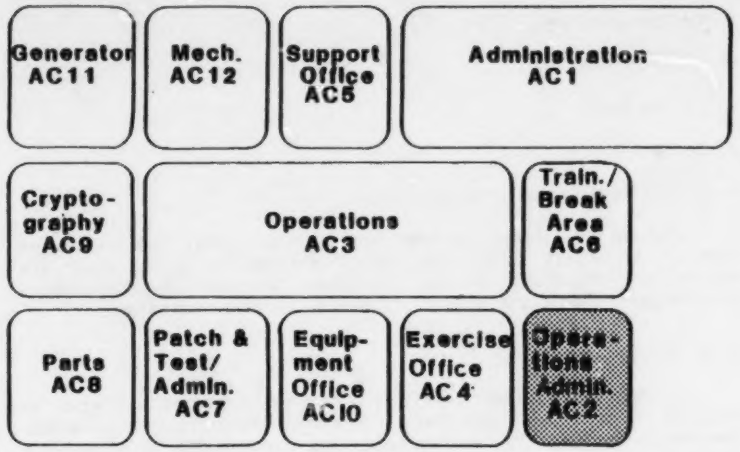
3. Acoustical and visual privacy

Divider partitions between workstations should be 60 inches high (± 4 inches) to provide visual privacy while occupants are seated--and yet should not be confining. Circulation paths around workstations should minimize disturbances to other workstations.

6. Electrical power

Workstation divider partitions can be tackboard surfaces to display maps, job examples, service equipment, and other information. Floor-to-ceiling poles are recommended to distribute electrical and communication lines to workstation modules. This eliminates floor wires at circulation paths and allows future module modifications at minimal cost.

OPERATIONS ADMINISTRATION AC2


Generator AC11
Mech. AC12
Support Office AC5
Administration AC1
Crypto-graphy AC9
Operations AC3
Train./Break Area AC6
Parts AC8
Patch & Test/Admin. AC7
Equip-ment Office AC10
Exercise Office AC 4
Opera-tions Admin. AC2

function

To support the operations activity. To establish and maintain the station's administrative processing of personnel records. To implement written and verbal SOP directives from chain of command orders, host agency regulations, and DCA policy for DCS. To provide a buffer and transition space between exterior and secure interior spaces.

policy/sop

issues and assumptions

1. Enclosed office versus open area workstation

Present noncommissioned officers in charge (NCOICs) and the assistants usually occupy an office workstation in the operations room itself. This makes their work more difficult because of the high noise and activity levels. If an enclosed office is provided, a view window to the console area must be provided.

activities

1. Distributing directives, orders and policy statements both written and verbal, to shift supervisors.
2. Initiating evaluation of equipment capabilities.
3. Developing personnel training plans and equipment evaluations.
4. Conferring with personnel (one-to-one).
5. Writing and typing reports.
6. Communicating operations and service functions.
7. Managing the operations function.
8. Planning for exercises and contingencies.

personnel

1. NCOIC and chief-in-charge.
2. Operations NCOIC.

equipment *

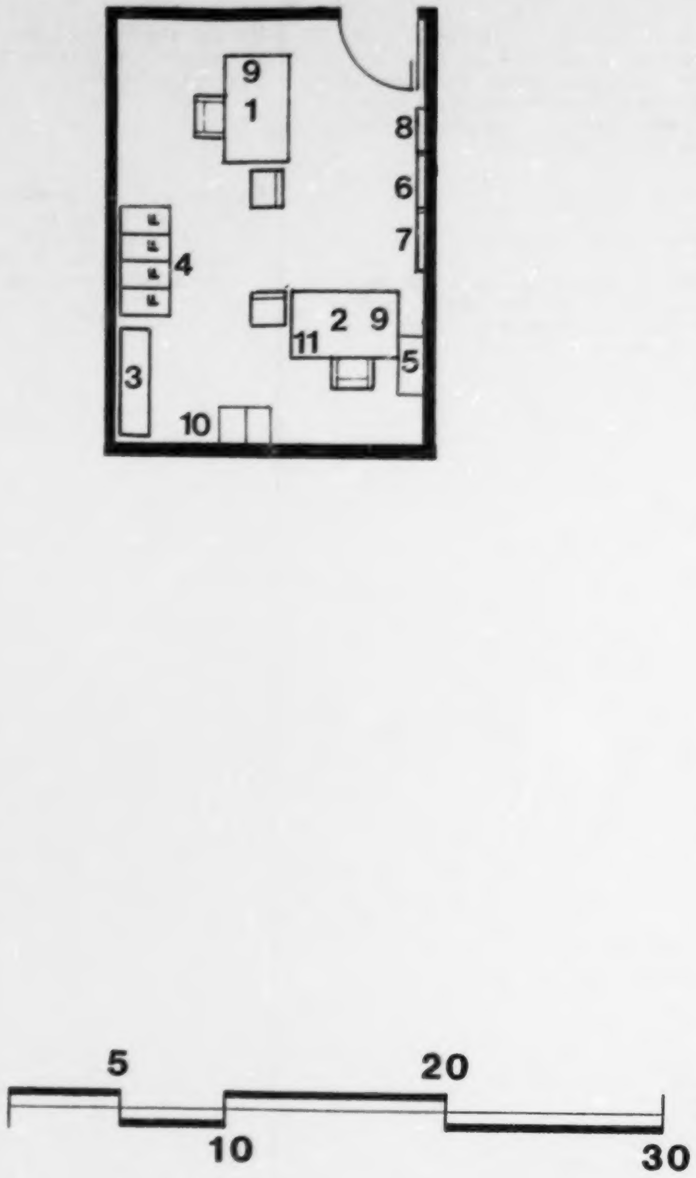
1. NCOIC workstations: desk/chair in open area (or with dividers).
2. Operations NCOIC workstation: desk/chair in open area (or with dividers).
3. Bookshelves--20 linear feet.
4. Four files, five drawers each.
5. Typewriter(s) with stand(s).
6. Tackboard.
7. Scheduling board and multiboard.
8. Station log.
9. Telephones.
10. Filesafe, five drawers.
11. Operational voice intercom control.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the administrative function.	**1.** Provide administrative space for two supervisory personnel with the required desks and chairs, bookcases, and file cabinets. Approximately 300 square feet are needed for two persons.	
2. Visual contact from offices to the operations floor to provide management with better opportunities to optimize personnel effectiveness.	**2.** Locate the administrative office space adjacent to the operations center console.	
3. Communication lines (outside/inside) for emergency operations and for internal interaction between offices and operations floor.	**3.** Coordinate telephone and intercom needs with the installation.	
4. Interior finishes suitable for durability, maintenance, and room function.	**4.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**4.** See also Vol 2, "Site and Building Information," SB2, Interior Construction and Finishes.
5. Acoustical isolation and attenuation for a nondisruptive environment.	**5.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .90, floor surface at NRC .50, and divider partitions (if used) at .85.	
6. Adequate lighting.	**6.** Use artificial lighting or natural if present. By quantitative and qualitative evaluation, provide: 20 to 30 footcandles general lighting. 60 to 80 footcandles task lighting. Surface reflectances: Ceiling--80 to 90 percent. Walls--40 to 60 percent. Floors--20 to 40 percent.	**6.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical Lighting.
7. Thermal comfort.	**7.** Regulate temperature at 68°F (heating), 78°F (cooling), with a 5-cubic feet per minute per person outside air ventilation rate.	**7.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.

requirements	criteria	commentary
8. Electrical power.	**8.** Install 120/208 electrical service. Receptacles (120-volt) should be located for convenience at each workstation and workbench at a suitable height for every 10 linear feet of wall. Electrical power must fall within the 10,000- to 500,000-watt range. Frequency levels should be at 50 to 60 hertz ± 5 percent.	**8.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
9. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe fire loss potential.	**9.** Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**9.** See Vol 2, Standardized Modules--Building Design Principles, and SB3; Fire Protection/Life Safety, for more information.

guidance



guidance

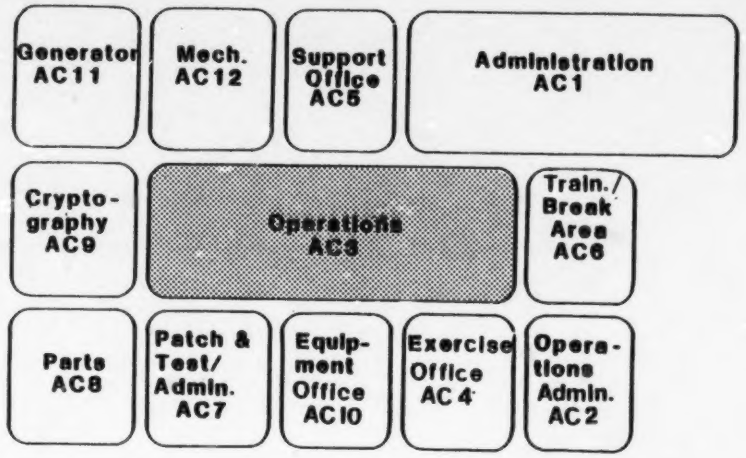
6. Work Area:

Light fixtures providing a uniform light intensity should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. The work area should also be provided with adjustable task lighting.

guidance

guidance

OPERATIONS AC3



function

To provide the "interface" function between the various transmission and switch elements of the DCS. Specifically, personnel and equipment monitor the DCS links and stations for AUTOVON, AUTODIN, TROPO-SC-, SatCom units. The operations room allows personnel to operate, maintain, monitor, and repair communication equipment optimally.

policy/sop

1. This Area Control (AC) facility includes the necessary physical, electrical, and manpower capabilities that provide (a) technical direction, (b) coordination, (c) technical supervision of transmission media and equipment, (d) quality control, (e) communications service restoral, and (f) status reporting for the various elements of the communication system.

2. In determining the layout when unencrypted signals bearing classified information will be present or processed, the specialized installation guidance in MIL-HDBK-232(C) must be consulted. Another major consideration should be the access necessary for installation, maintenance, and operation. This would include considerations such as providing adequate space between rows of equipment to allow for operating cabinet doors or sliding out modules for maintenance. (2) 5-20

3. Other equipment layout considerations include minimizing interbay cabling runs, providing for future expansion, and providing easy access for maintenance and operational convenience. Equipment of the same type or with similar function usually is grouped together except when impractical due to size and/or specific station requirements. (2) 5-20

4. Components should be grouped properly according to their function and interoperation. Care should be taken in arranging meters, test equipment, jackfields, indicating lights, etc. to insure they are placed at the approximate eye level, thus allowing rapid, convenient use. Equipment should not be mounted at the bottom of a bay if it can be damaged easily or if its size and shape will interfere with power boxes or other hardware at the bottom of the cabinet or rack. (2) 5-21

5. The station's operational plan must be studied when placing each component or rack assembly to determine the communication circuit requirements. In small stations, it is recommended that the equipment be positioned with enough space in between to accommodate a normal floor traffic pattern. However, this type layout will generally not be suitable in stations with great numbers of equipment. In the large station, the most practical layout usually is one in which the equipment is aligned in bays across the width of the room, with enough space between bays to permit free access to each rack assembly. (2) 5-22

issues and assumptions

1. Automated recordkeeping

CRTs with hardline printers can streamline paperwork by storing all circuit history files on disks, thus eliminating time-consuming paperwork. This will allow troubleshooting to be done much more rapidly in-house.

2. Electromagnetic compatibility (2) 5-43

Electromagnetic compatibility (EMC) is a complex subject with specialists often required to perform the type of EMC study needed to insure that the equipment or equipment layout produces no interferences or radiation hazard.

New DOD reguations control permissible levels of electromagnetic pollution of the frequency spectrum in an effort to protect the environment. Radiation hazards also are being regulated through concern for occupational safety. Engineering agencies under contract with DOD must therefore be aware of the legal and regulatory aspects of EMC and radiation hazard to meet these requirements.

Military specifications on EMC, such as MIL-STD-461, 462, and 463, are intended to control and achieve an acceptable figure of merit or quality in the development of new communications equipment. They do not eliminate the need for EMC engineering in facility design. In addition to equipment quality, frequency selection, nearness to other facilities and, to some extent, the facility design itself are variables in the interference generation problem. (2) 5-43

3. Determining the correct shielding procedure

A comprehensive approach to shielding equipment from RFI or TEMPEST involves (a) a building layout to optimize inherent facility shielding conditions, (b) appropriate location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components.

See Vol 2, SB4 for additional guidance.

activities

1. Sending link and station outage messages.
2. Supervising controllers.
3. Isolating fault.
4. Monitoring communication equipment (patch and test).
5. Typing reports.
6. Training personnel.
7. Checking security.
8. Performing quality control maintenance tests.

personnel

1. One shift supervisor.
2. Four technical controllers.

equipment *

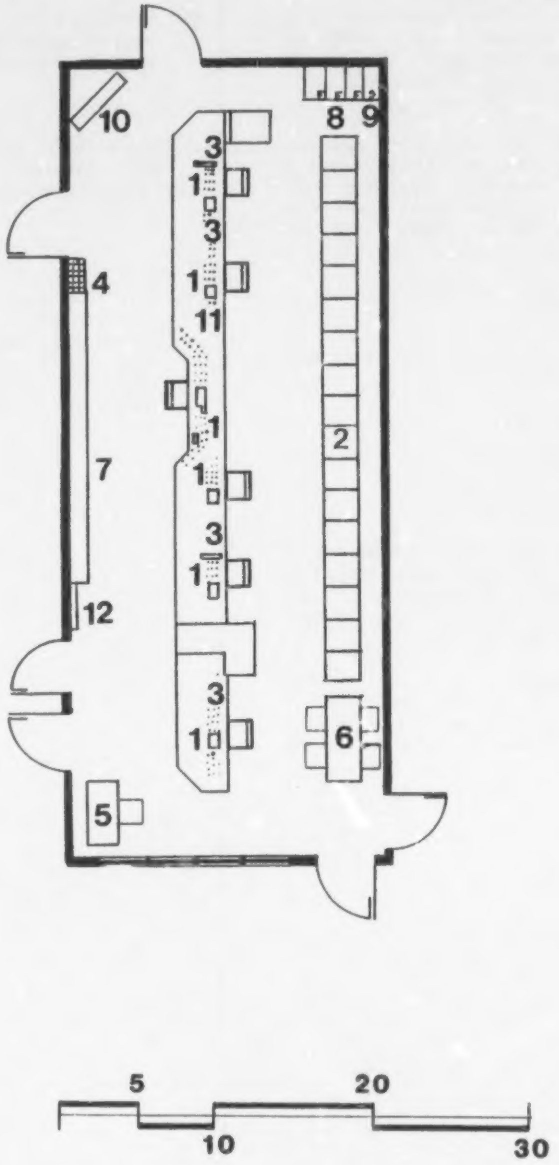
1. Monitoring consoles.
2. Teletypes (24).
3. Telephones.
4. Quality assurance test equipment.
5. Desk with chair.
6. Tables.
7. Shelving (20 linear feet) for manuals.
8. Three file cabinets, four drawers each.
9. Filesafe for classified information, five-drawers.
10. Mapboard of system stations and links.
11. Operational voice intercom control.
12. Electrical shock first-aid kit.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Adequate space for the operation and monitoring of communications-electronics (C-E) equipment. Spatial requirements must allow for proper spacing between equipment to facilitate easy maintenance.	**1.** Varies due to extent of communication equipment design. See layout in Guidance. Approximately 1000 to 1200 square feet are required.	
2. A secure environment for C-E equipment.	**2.** The operations room must be lockable when unstaffed and must be supplied with an intrusion alarm system. The operations console should be fitted with alarms for intrusion, power failure, and generator status. Covers should be provided on overhead rods for rapid sanitizing of applicable equipment.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Signal shielding.	**3.** See Vol 2, SB4--Grounding, Bonding and Shielding along with SB7--Security Systems for more information.	
4. EMP/HEMP shielding.	**4.** Shielding is necessary for survivability and uninterrupted functioning when the facility is subjected to EM pulse (EMP) and high-altitude EM pulse (HEMP). Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	**4.** See Vol 2, SB5, EMP/HEMP Protection, for more information.
5. Raised floor system.	**5.** Raised or false floors are necessary for proper cooling of the equipment.	**5.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
6. Interior finishes suitable for durability, maintenance, and room function.	**6.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor with a dust-on finish that contains a hardener. See Vol 2, SB2--Interior Construction. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Wall--Paint over concrete, gypsum board, or plaster and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	**6.** See also Vol 2, SB2, Interior Construction and Finishes.
7. Acoustical isolation attenuation for variable noise levels produced by electronic equipment.	**7.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile is also required to within 4 feet of the floor.	
8. Adequate lighting.	**8.** Lighting shall be specially engineered. Low levels of lighting may be required to permit observation of luminous panels without reflected glare or undesirable contrasts in brightness. Separately controlled luminaires shall be provided for normally lighted operations and for cleaning, with an ambient level of 70 footcandles from fluorescent fixtures.	**8.** For further information on quality lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.

requirements	criteria	commentary
9. Controlled environment for proper operation.	**9.** Maintain 70°F (±2°) and 50 percent relative humidity (± 5 percent continuously. Provide 5 cubic feet per minute per person outside air ventilation rate or the outside air quantity necessary to maintain a room pressurization requirement of .05 to .10 water gage.	**9.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
10. Electrical power.	**10.** Provide 120/128 electrical service and 120-volt outlets--one receptacle for every 10 linear feet of wall. Outlets for equipment should be available under the raised floor as per layout. Electrical power must fall within the 10,000 to 500,000 watt range, with frequency levels at 50 to 60 hertz ± 5 percent.	**10.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**11.** Vaulted enclosure walls--2 hour (minimum) fire-rated, shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area--Automatic fire detection: Local alarm. Automatic Halon 1301 suppression system if required for cross-zoned or matrix detection. Sprinkler and Halon systems are not normally installed in the same areas.	**11.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Equipment expansion

It is advisable to arrange equipment in the equipment room such that future expansion of the building will not necessitate complete rearrangement. (2) 5-21

Approximately 3 feet of clearance space, as a minimum, should be allowed in front of and to the rear of an equipment bay. If a bay does not permit rear access to equipment, the bay can be installed with no clearance on the back side, that is, against a wall or back-to-back with other bays, unless ventilation requirements are compromised. (2) 5-21

5. Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on raised floors for maximal use of coupled air directly through the cabinets. Cooling air at 60°F supplied directly into the base of the transmitters will leave the top at approximately 72°F. Thus, when the air exits the equipment, it is at a more comfortable temperature for persons working in the space.

8. Control area

Light fixtures should provide an approximate uniform lighting intensity of 70 footcandles and should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. Lights over the area in which the control console is located shall be provided with wide-range (100:1) dimming control. (23)12

Equipment area

Fixtures should be arranged above the operating aisles and should run parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so light is not obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23)12 Portable task lighting should also be supplied for the equipment area at 70 to 100 footcandles.

9. Protection from moisture migration

Operating spaces that contain electronic equipment usually require close temperature and humidity control. Vapor barriers placed under floor slabs and roofing usually prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided if exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

guidance

Mechanical

The recommended operating temperatures and humidity conditions should be obtained from the manufacturers of the communications and data processing equipment and should be used in designing the environmental control system.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Inadequate cooling contributes as much to failure as poorly regulated power. (74) 4-17

Even though certain individual units can operate outside the limits of the overall specifications, overall environmental requirements are dictated by the most restrictive unit of the system. The computer system's requirements are the major considerations; however, good design will also consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in the following ways. (74) 4-17

- Heat dissipation by computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The number of air changes per hour varies between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Also, if the air-conditioning requirements are not met, a record must be available to indicate the extent and duration of the undesirable condition and indicate whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-25

guidance

- Insure the air-conditioning system continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is needed when humidity limitations are exceeded. Drying out may be necessary if the excess humidity occurs either during periods of actual operation or while the machine is shut down and unattended. The extent and duration of excessive humidity determines the length of the drying-out period.
- Determine if the environment meets requirements for the machine.

A visual or audible signaling device is desirable in the recording instrument. This is to provide visual or audible indication that temperature or humidity in the computer area is nearing the maximum limit.

Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The recorder is usually located at a representative spot in the room and adjacent to the control devices.

For monitoring underfloor air conditions, a remote indicating instrument is recommended. This is usually a 7-day electric-drive chart and can be the wet-and-dry-bulb or electronic type if direct reading is not available. The recording instrument can be located on the wall in the operations room, in the mechanical equipment room, or in any other location convenient to the building engineer.

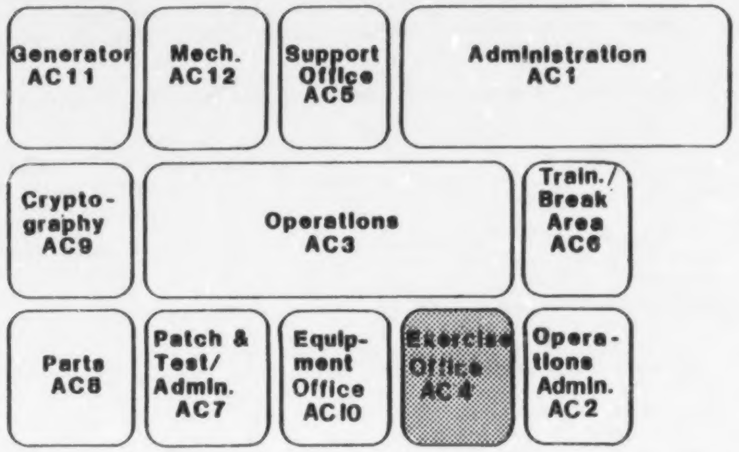
10. Electrical

Consider providing a flexible system that will meet the facility's future requirements. Electronic equipment is constantly being upgraded, modified, and replaced. Bus duct systems and cable trays may prove to be most flexible for areas in which new equipment is expected or that may have frequent modification. (5) 3-4-8

Specifically refer to the "Electrical" portion of "Issues and Assumptions" portion of SB2, Vol. 2, for information relative to host nation power requirements. Additional information may be found in "guidance" of SB2 with respect to the standard frequencies and voltage levels used by various nations.

Provide host nation standard outlets if applicable.

EXERCISE OFFICE AC4


Generator AC11
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Operations AC3
Train./Break Area AC6
Parts AC8
Patch & Test/ Admin. AC7
Equip-ment Office AC10
Exercise Office AC4
Opera-tions Admin. AC2

function

To support assigned personnel who develop contingencies and exercises for personnel training and equipment testing.

policy/sop

issues and assumptions

activities

1. Writing exercise programs.
2. Reading computer printouts (hard copy).
3. Typing reports.
4. Storing computer printouts (hard copy).
5. Storing magnetic tapes.
6. Storing computer cards.

personnel

1. Three--one officer in charge and two noncommissioned officers.

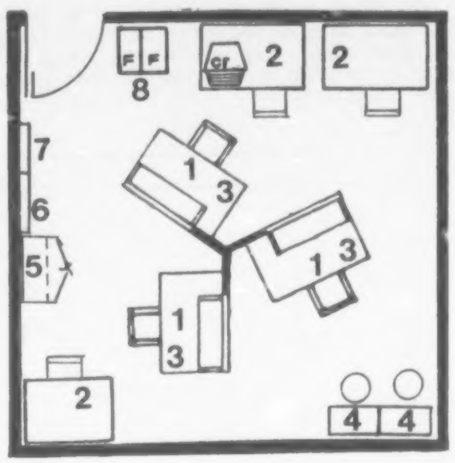
equipment *

1. Three desks with chairs.
2. Three tables--one with CRT terminal and one for printer.
3. Telephone.
4. Two typewriters with stands.
5. Cabinets with shelving for tapes, cards, and printouts.
6. Status board (wall-mounted).
7. Display board.
8. Two files, five drawers each.
9. Intercom speaker.

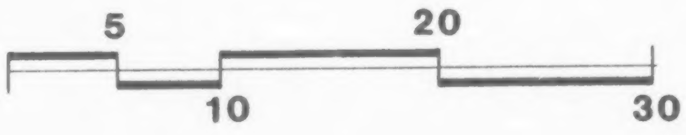
* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate the equipment and furniture associated with the exercise function.	1. Provide approximately 400 square feet, or 135 square feet per person.	
2. Security.	2. Area must be lockable when unstaffed and must have an intrusion alarm system.	2. See Vol 2, SB7, Security (Zone 3), for more information.
3. Interior finishes suitable for durability, maintenance, and room function.	3. Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	3. See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation for a nondisruptive environment.	4. The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	
5. Adequate lighting.	5. General: 20 to 50 footcandles. Task: 70 to 150 footcandles. VDTs require 5 to 10 footcandles. Provide adjustable arm task lighting. Surface reflectances: Ceiling: 80 to 90 percent. Walls: 30 to 80 percent (wall at person's back should be 10 to 20 percent). Floor: 15 to 40 percent.	5. For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
6. Comfort: Thermal. Occupant.	6. Temperature must be maintainable at 68°F (heating), 78°F (cooling), with 5 cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent backrest adjustment.	6. See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	7. Install 120/208 electrical service. Locate 120-volt receptacles at all workstations at a convenient height and/or for every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	7. See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	8. Interior finish: Class A or B only. Automatic fire suppression: Water sprinklers. Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	8. See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



9 -- speaker in ceiling



guidance

1. Location

Direct access to operations.
Direct access to intelligence officer.
Direct access to shredder.

5. Lighting design

To reduce glare at VDTs, equip fluorescent light fixtures with specular parabolic louvers. A louver with cell dimensions of 1.5 by 1.5 inches or smaller will give a high visual comfort probability (VCP) value. A diffuser along with a parabolic louver may also be helpful. Some pigmented acrylic lenses and nonparabolic metal louver panels can also have high VCP values.

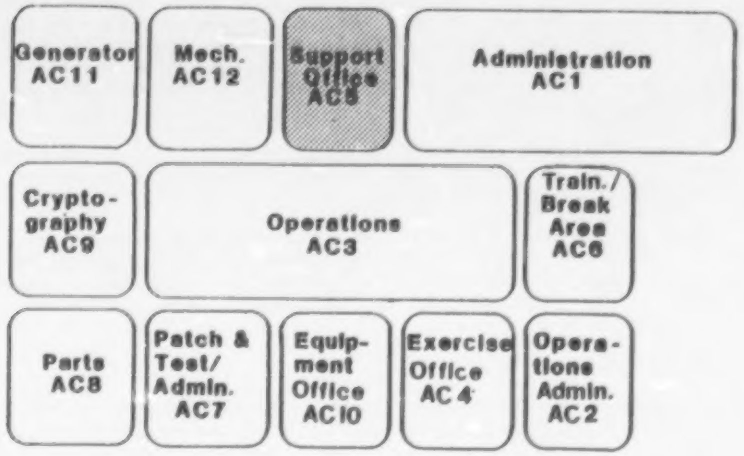
The suggested cell size for a parabolic louver is 1 by 1 inch down to .5 by .5 inch. On tall ceilings the cell depth needs to be greater, which may dictate a larger cell size.

Glare from windows and reflections from walls and other surfaces must be controlled, especially on the surface immediately behind the VDT. Walls and work surfaces with a matte finish are best. Wall carpeting also is recommended for its noise control and virtual elimination of reflections.

6. Electrical power

The use of floor-to-ceiling "poles" to distribute electrical and communication lines to workstation modules is recommended to eliminate floor wires at circulation paths and to make future modifications to the module at minimal cost.

SUPPORT OFFICE AC5


Generator AC11
Mech. AC12
Support Office AC5
Administration AC1
Crypto-graphy AC9
Operations AC3
Train./Break Area AC6
Parts AC8
Patch & Test/Admin. AC7
Equip-ment Office AC10
Exercise Office AC 4
Opera-tions Admin. AC2

function

Establish and maintain the center's administrative processing of outage correction. Implement written and verbal SOP directives from "chain of command" orders, host agency regulations and DCA policy for DCS. The personnel provide a coordination function between the DCS stations and the using customers of the DCS.

policy/sop

issues and assumptions

activities

1. Distributing outage reports, both written and verbal, to DCS station and customers.
2. Intiating evaluations of equipment capabilities for correcting system communication service to customers.
3. Staffing computer interface via a CRT terminal.
4. Giving real-time reports of outages.
5. Backing operations-floor personnel.

personnel

1. A/O supervisor.
2. 55-1 report NCO.

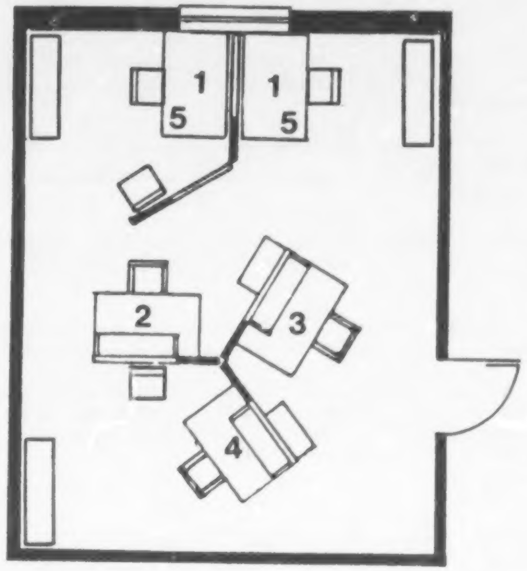
equipment *

1. Two NCO workstations: two desks with chairs, two side chairs, and bookshelves (20 linear feet each).
2. CRT terminal with printer.
3. Teletype terminal.
4. Microfiche reader.
5. Telephone.
6. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the administrative function.	**1.** Provide administrative space for supervisory personnel. This area varies with the number of assigned personnel, but is typically about 500 square feet.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Carpet. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	**3.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	
4. Adequate lighting.	**4.** Provide 80 footcandles for task lighting at work surfaces with 40 footcandles for the ambient level. Surface reflectances should be: o Ceilings--80 to 90 percent o Walls--40 to 60 percent o Floor--20 to 40 percent.	**4.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for the occupant.	**5.** Maintain temperature at 68^{o}F (heating), 78^{o}F (cooling), with 5 cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	
6. Electrical power.	**6.** Provide 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppresion--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunicator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



6-- speaker in ceiling

guidance

1. Location

Windows to the outside are recommended for CONUS facilities on secure sites, such as military installations. OCONUS facilities usually should have a minimum of windows to limit opportunities for forced entry.

Activity subspaces

- Enclosed offices
- Workstations
- Filing area
- Reception.

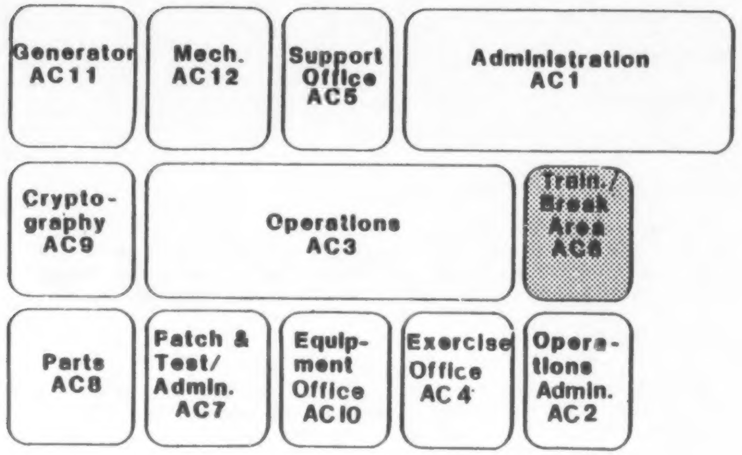
3. Acoustical and visual privacy

Divider partitions between workstations should be 60 inches high (± 4 inches) to provide visual privacy while occupants are seated--and yet should not be confining. Circulation paths around workstations should minimize disturbances to other workstations.

6. Electrical power

Workstation divider partitions can be tackboard surfaces to display maps, job examples, service equipment, and other information. Floor-to-ceiling poles are recommended to distribute electrical and communication lines to workstation modules. This eliminates floor wires at circulation paths and allows future module modifications at minimal cost.

TRAINING /BREAK AREA AC6



function

To create a change of environment for on-duty personnel as a break from the hard-surface equipment room and work areas.

To improve personnel capability and effectiveness, both technically and personally. To allow development and implementation of station master training program.

policy/sop

Personnel support

1. The intense activities inside DCS facilities generate personnel fatigue, making it necessary to provide an area separate from the communication function.
2. Current policy requires personnel to have a 15-minute break every 3 to 4 hours. Typical schedules also allow 30-minute meal breaks.
3. Most communication personnel "brown bag" their meals since they cannot leave the facility during a shift. Therefore, basic food preparation equipment is required: a kitchenette-sink, hot plate, refrigerator, cabinets, and range.

Training

1. Technical training occurs at two levels: (a) hands-on experience, i.e., working directly with the communications equipment and (b) learning from manuals, publications, and audiovisual equipment. Physical training also proceeds at two levels: (a) interior individual exercise and (b) exterior small-group recreational activities, especially at remote DCS facilities that are not on a military installation.
2. Current policy requires that personnel be allowed time for technical training while on-duty at the facility.
3. Training usually proceeds while the communication activity is at its lowest level.
4. Some communications personnel may be engaged in a CDC (Current Development Course); a training area is required for this program. (The Air Force counterpart is the QTP [Quick Training Package].)
5. Training usually is conducted by the shift supervisor or a lead non-commissioned/commissioned officer who also is on duty.
6. In fire/life safety training, "safety" implies the absence and/or control of conditions that can cause personal injury or death or damage to or loss of equipment or property. Within the system, safety is concerned with eliminating or controlling factors affecting the safe, efficient operation of personnel, equipment, and facilities organized to attain a common goal.

   The objective of safety "training" is to insure maximum freedom from inadvertent and possible destructive mishaps resulting from facilities, equipment, procedural, or personnel deficiencies during all phases of system operation. (70) 15-30

issues and assumptions

1. Three-shift versus four-shift impact on training time available

Most facilities operate on a three-shift basis:

Day shift:	8 a.m.	4 p.m.
Swing shift:	4 p.m.	Midnight
Midshift:	Midnight	8 a.m.

By having personnel assigned to four shifts instead of three, one group could be a training shift that would be on duty during the daytime shift; thus, the peak activity period woud have twice as many personnel available if required. In addition, this arrangement would give trainees the best opportunity to interact with facility functions.

The four-shift concept, however, assumes one or both of the following:

a. More people will be assigned to the site.

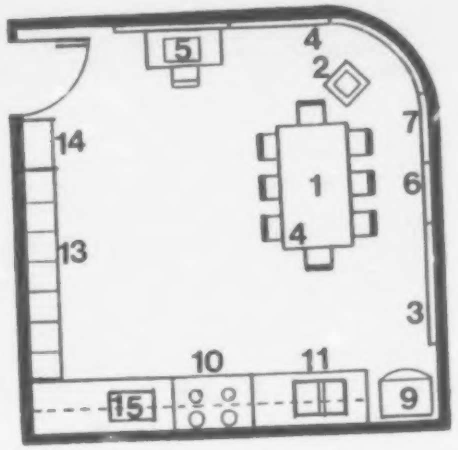
b. Staffing of the three operating shifts can be reduced.

activities	personnel	equipment *
1. Observing evaluation personnel records and conducting personnel interviews to determine training requirements. 2. Developing overall master training plan and presenting special MOS training module program for a specific focus. 3. Reading and studying manuals and publications. 4. Watching video cassettes, 16-millimeter movies, and slides. 5. Conducting fire/life mission safety instruction.	Instructors 1. Commander. 2. Noncommissioned officer in charge. 3. Civilian technicians (not an office area for personnel).	Classroom/conference **1.** Table and seating for four to eight. **2.** Viewgraph projection setup. **3.** Charts and display panels. **4.** Audiovisual projector and screens. **5.** TEC library monitors. **6.** Chalkboard. **7.** Tackboard for training and information bulletins. **8.** Intercom speaker.
Break area 1. Relaxing. 2. Reading. 3. Eating. 4. Storing food. 5. Preparing food. 6. Storing personal items, i.e., coats and books.	1. Two to eight personnel at once.	**9.** Refrigerator. **10.** Range and range hood. **11.** Sink (20 by 30 inches) within countertop, with cabinets above. **12.** Trash receptacles. **13.** Personnel storage lockers for each staff member (not required for personnel complement with private offices). **14.** Coat rack. **15.** Microwave oven.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the personnel support/break area.	**1.** Provide approximately 500 square feet of space for equipment and furniture to accommodate up to 15 personnel.	
2. Visual separation from the communications equipment.	**2.** Provide visual separation that also allows viewing of the operations area when desired. Supply comfortable furniture and carpeting (earth tones are recommended).	
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Vinyl asbestos tile and area carpeting. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation for a nondisruptive environment.	**4.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**4.** See reference 201, page 3-4, Table 3-2.
5. Lighting suitable for reading (task and ambient).	**5.** Provide adjustable lighting, depending on the varied uses: 20 to 80 footcandles for work surfaces 10 footcandles at rear of room during audiovisual projection. Surface reflectances: Ceiling: 80 to 90 percent Walls: 40 to 60 percent Floor: 20 to 40 percent.	
6. Thermal comfort.	**6.** Control temperature for 68°F (heating) and 78°F (cooling) with a 5-cubic feet per minute per person outside air ventilation rate.	**6.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Provide 120/208 electrical service. 120-volt outlets should be installed for every 10 linear feet of wall. Counter height outlets are required for a coffee maker, mixer, microwave oven (when permitted), and other appliances.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**8.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety for more information.

guidance



8-- speaker in ceiling

guidance

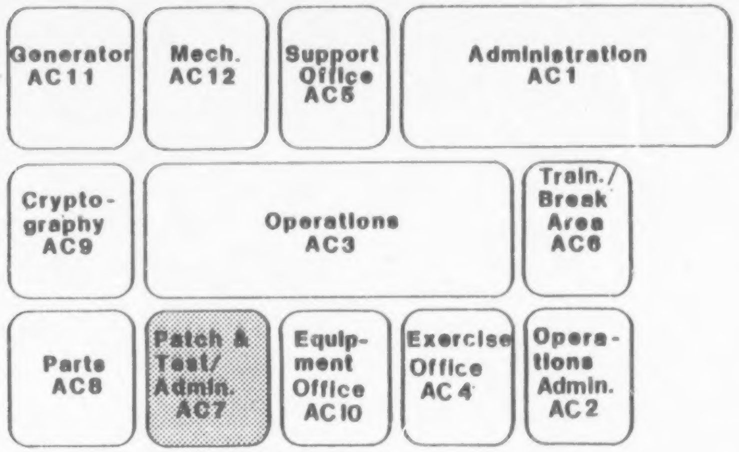
1. Location

The personnel space should be directly adjacent to the operations room, but isolated acoustically (absorptive walls) and visually (a curtain hung at the window).

3. Visual comfort

The color contrast, textures, and designs of the wall, ceiling, and floor surfaces should minimize glare for a comfortable environment.

PATCH AND TEST/MAINTENANCE AC7


Generator AC11
Mech. AC12
Support Office AC5
Administration AC1
Cryptography AC9
Operations AC3
Train./Break Area AC6
Parts AC8
Patch & Test/Admin. AC7
Equipment Office AC10
Exercise Office AC4
Operations Admin. AC2

function

To support assigned personnel who repair, clean, and test communication equipment. "Patch and test" refers to the monitoring of communications in order to provide continuous operation with minimal loss of service, and no loss of traffic.

policy/sop

1. To test and service a communications system properly, maintenance personnel should have a thorough understanding of the equipment's physical makeup, operational characteristics, capabilities, and limitations, and should be familiar with the circuit theory of operation. Equally important is that the proper test equipment be available to these personnel. As maintenance responsibility progresses from onsite field to depot maintenance, numbers and requirements of the test equipment required will increase, necessitating improved facility responsiveness. (70) 7-51

issues and assumptions

activities

1. Inspecting and diagnosing equipment and parts.
2. Completing preventive and unscheduled maintenance.
3. Assembling electronics.
4. Testing electronics.
5. Insuring secure storage for parts and equipment.
6. Maintaining records on parts and equipment.
7. Writing/typing reports:
   - o PMI 349s
   - o Equipment historical records.
8. Preparing training plans.
9. Monitoring CRYPTO synchronization panel.
10. Troubleshooting and patching to good equipment.
11. Identifying bad connections.
12. Notifying contractor on CRYPTO when problems arise.

personnel

1. Shift supervisor.
2. Four teletype technicians.
3. Two CRYPTO technicians.

equipment *

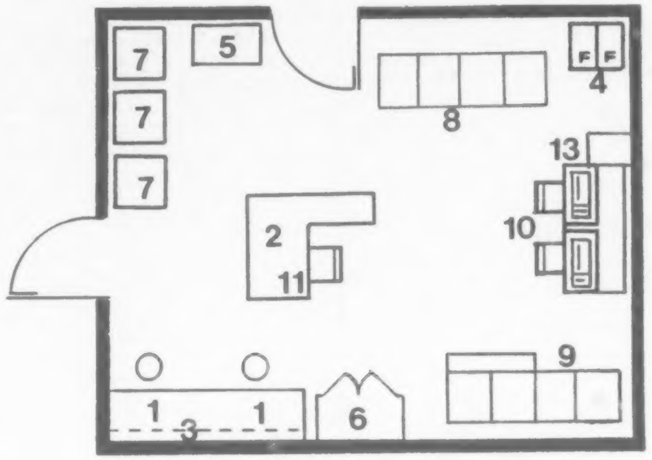
1. Two electronic work benches with stools.
2. Desk with chair and typing stand.
3. Shelving over workbench for publications/manuals.
4. File cabinet.
5. Portable vacuum sweeper to clean equipment parts. If compressed air blower unit is used instead, use a maximum of 30 pounds per square inch to prevent damage to parts. (Use with a dust collector.)
6. Locked storage cabinets (secured to wall) for special electronic equipment.
7. Set of three sonic cleaners (3 by 3 feet each).
8. Patch and test bays.
9. Multiplex racks.
10. Printer (hard copy).
11. Telephone.
12. Shelving for manuals and publications.
13. Filesafes (two) for records.
14. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

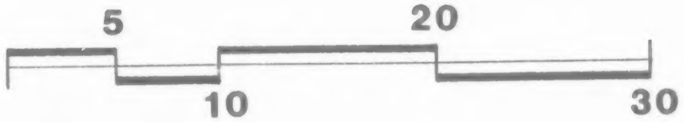
requirements	criteria	commentary
1. Enough space to accommodate the patch panels, console, and printer. Space also must be available for the equipment and furniture associated with the supervisory function.	**1.** Varies due to extent of equipment designed. See Guidance for a typical installation.	
2. Enough space for storing, inspecting, and testing communication equipment.	**2.** A 48-inch workspace behind all equipment for inspection, testing, and repair.	
3. RFI shielding.	**3.** Electrical and electronic equipment must be shielded to prevent it from propagating interference and to protect it from the effects of interference propagated by other electrical devices. (15a) 7	**3.** See Vol 2, SB4, Grounding, Bonding and Shielding, along with SB5, EMP/HEMP Protection.
4. Raised floor system.	**4.** Raised or false floors are needed for proper cooling of the equipment.	**4.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
5. Interior finishes suitable for durability, maintenance, and room function.	**5.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor that has a dusted-on finish containing a hardener. See Vol 2, SB2, Interior Construction.	**5.** See also Vol 2, Site and Building Information, SB2, Interior Construction and Finishes.
6. Acoustical isolation/attenuation of variable noise levels produced by electrical equipment.	**6.** Adjacent rooms' walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile also is required to within 4 feet of the floor.	
7. Adequate lighting.	**7.** Ambient--20 footcandles; task--70 to 100 footcandles (testing and inspection).	
8. Environmental control for proper operation of electronic equipment.	**8.** Temperature--73°F (±2°); relative humidity--50 percent (±5 percent). The transmission area must have filtered air. (See MIL-HDBK-411A.)	**8.** See also Vol 2, Communication Station Buildings--Mechanical.
9. Electrical power.	**9.** Provide 120/208 electrical service. Electric power may fall within the 10,000- to 50,000-watt range. Install one 120-volt outlet for every 10 linear feet of wall and as required for coordination with equipment.	**9.** See also Vol 2, SB2, Communication Station Buildings--Electrical.

requirements	criteria	commentary
10. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition. houses critical equipment and data that have a severe strategic fire loss potential.	**10.** Vaulted enclosure walls--2 hour (minimum) fire-rated, shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers.	**10.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



14-- speaker in ceiling



guidance

4. Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on raised floors for maximal use of coupled air directly through the cabinets. Cooling air at 60^{O}F supplied directly into the base of the transmitters will leave the top at approximately 72^{O}F. Thus, when the air exits the equipment, it is at a more comfortable temperature for persons working in the space.

7. Equipment area

Fixtures should be arranged above the operating aisles and should run parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so light is not obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23) 12 Portable task lighting should also be supplied for the equipment area at 70 to 100 footcandles.

8. Protection from moisture migration

Operating spaces that contain electronic equipment usually require close temperature and humidity control. Vapor barriers placed under floor slabs and roofing usually prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided if exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Inadequate cooling contributes as much to failure as poorly regulated power. (74) 4-17

Even though certain individual units can operate outside the limits of the overall specifications, overall environmental requirements are dictated by the most restrictive unit of the system. The computer system's requirements are the major considerations; however, good design will also consider personnel comfort. (74) 4-17

guidance

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in the following ways. (74) 4-17

- Heat dissipation by computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The number of air changes per hour varies between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Also, if the air-conditioning requirements are not met, a record must be available to indicate the extent and duration of the undesirable condition and indicate whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-25.

- Insure the air-conditioning system continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is needed when humidity limitations are exceeded. Drying out may be necessary if the excess humidity occurs either during periods of actual operation or while the machine is shut down and unattended. The extent and duration of excessive humidity determines the length of the drying-out period.
- Determine if the environment meets requirements for the machine.

A visual or audible signaling device is desirable in the recording instrument. This is to provide visual or audible indication that temperature or humidity in the computer area is nearing the maximum limit.

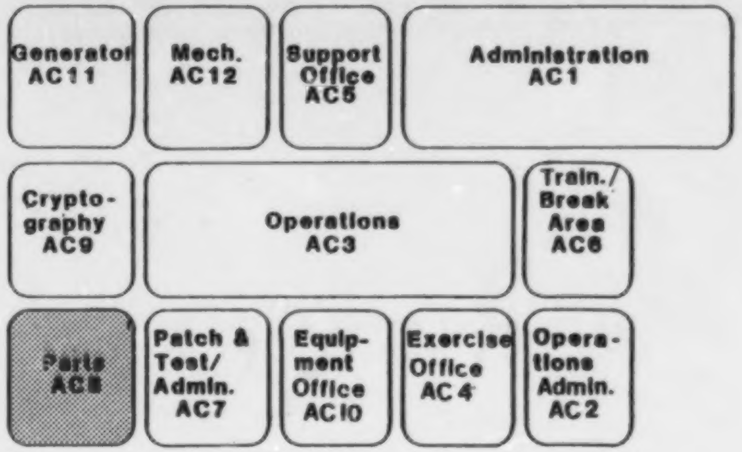
guidance

Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The recorder is usually located at a representative spot in the room and adjacent to the control devices.

For monitoring underfloor air conditions, a remote indicating instrument is recommended. This is usually a 7-day electric-drive chart and can be the wet-and-dry-bulb or electronic type if direct reading is not available. The recording instrument can be located on the wall in the operations room, in the mechanical equipment room, or in any other location convenient to the building engineer.

best copy available

PARTS AC8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Equip-ment Office AC10
Exercise Office AC4
Opera-tions Admin. AC2

function

This element is the space required to manage all parts supply operations: ordering, receiving, storage, inventory, and security.

policy/sop

1. Requirements for spare parts storage space are determined by the type of equipment at the installation and the level of maintenance to be performed onsite.

2. During preventive maintenance inspections, it may be noticed that some components' performance has deteriorated. Rather than wait for the component to become weaker or to fail completely and cause system interruption, it is considered good maintenance practice to replace the faulty parts during the inspection. Although components would be replaced before their full service life has been realized, service interruptions could be avoided. This practice would, in turn, increase the expected replacement parts cost for an operating system; however, the increase would be justified on the basis of increased system reliability and savings for additional manpower costs that would be incurred in making special trips to unattended stations to restore system operation. (70) 7-49

issues and assumptions

activities

1. Developing parts order lists and working with station Central Supply Office.
2. Receiving, unpacking, shelving of prescribed load list and facility supply parts.
3. Packing and shipping repairable items.

personnel

1. One supply specialist.

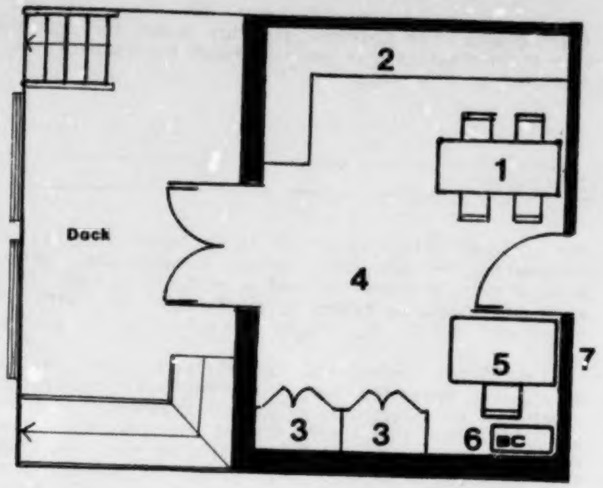
equipment *

1. Table (30 by 60 inches) with chair.
2. Shelving--30 linear feet, floor-to-ceiling type.
3. Three locked cabinets (24 by 36 inches).
4. Open area (100 square feet) for unpacking orders.
5. Desk with chair for parts ordering, microfiche unit.
6. Bookcase for supply manuals--3 to 4 linear feet.
7. Intercom speaker.

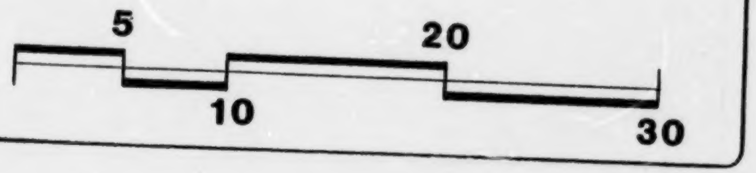
* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for ordering, receiving, and storing C-E equipment. Space must include an open area to facilitate easy receiving of large equipment and supply orders.	**1.** Provide approximately 300 square feet to accommodate storage shelves and to leave an open area for receiving shipments of parts and supplies.	
2. A secure environment.	**2.** This area must be lockable when unstaffed. Provide an intrusion alarm system.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation: Acoustical comfort for a nondisruptive environment.	**4.** Adjacent room walls should limit sound transmission to 40 decibels.	
5. Adequate lighting.	**5.** Lighting should be: 20 footcandles (ambient) and 70 footcandles (task).	
6. Environmental control for proper storage of electronic equipment.	**6.** Regulate temperature at 68°F (heating), 78°F (cooling), with a 5-cubic feet per minute per person outside air ventilation rate.	**6.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Supply 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and for every 10 linear feet of wall. Required frequency levels are 50 to 60 hertz ± 5 percent.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**8.** Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



7-- speaker in ceiling



guidance

1. Location

Locate the parts area between the exterior receiving dock and the maintenance room.

Provide an open area for unpacking equipment before it is moved into operation or equipment rooms.

A loading dock should be designed for a minimum load of 250 pounds per square foot and should provide enough room to maneuver equipment.

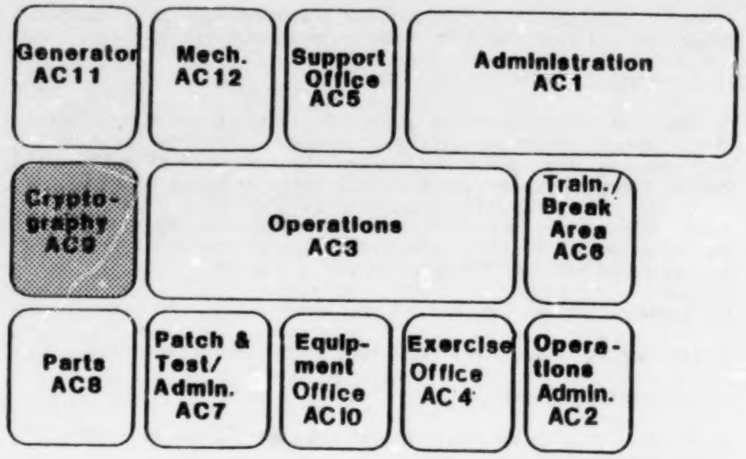
2. Door security

Maintenance/utility doors not permitting entry to administrative/-operational spaces should be secured with heavy cylindrical case lock and latch sets in conformance with Federal Specification FF-H-106 and with Builders Hardware Manufacturers Association Standard 501. Doors and hatches that are externally accessible and lead to critical utilities should be secured with padlocks and hasps in conformance with Military Specification MIL-P-43607 instead of or in addition to the cylindrical case or bored locksets specified above. (5) 3-5-9

The hardware set for secure doors should be:

- 1/8-inch-thick drill-resistant hard plate for inside of door
- Secured-type hinges
- Cypher lock with an electronic access control, electric strike, and emergency battery standby
- Combination lock
- Door closer (on each leaf if pair door is required)
- Wide-angle peephole
- Foot bolts and pull-chain bolt for inactive leaf of pair doors.

CRYPTOGRAPHY AC9


Generator AC11
Mech. AC12
Support Office AC5
Administration AC1
Crypto-graphy AC9
Operations AC3
Train./Break Area AC6
Parts AC8
Patch & Test/ Admin. AC7
Equip-ment Office AC10
Exercise Office AC4
Opera-tions Admin. AC2

function

The cryptography area provides a secure place for encryption or decryption of information that passes through the communication facility.

policy/sop

1. The national policy objective is to insure that national security information is not lost through unintentional emanations. To achieve this, equipment should be designed to meet TEMPEST requirements and should be tested to verify compliance with TEMPEST specifications. See Vol 2, SB4, for additional guidance information.

2. The RED/BLACK concept is the basis for the facility criteria development presented here. The RED/BLACK concept dictates that electrical and electronic circuits, components, equipment, systems, and other items that handle national security plain language information in electrical signal form (RED) be separated from those handling encrypted or unclassified information (BLACK). Under this concept, RED and BLACK terminology is used to clarify specific criteria relating to the difference between such circuits, components, equipment, and systems, and the area in which they are contained.

issues and assumptions

1. Proper location for cryptographic equipment

Locate sensitive and critical equipment as close to the core of the structure as operational requirements permit. In addition, identify the location of likely sources of interference such as power substations, engine-generators, and RF transmitters; maximize the separation between such sources and potentially susceptible equipment or systems. (15b) 1-173

2. Electromagnetic compatibility (2) 5-43

Electromagnetic compatibility (EMC) is a complex subject, so that specialists often are needed to perform the type of EMC study needed to insure that the equipment or equipment layout produces no interference or radiation hazard.

DOD is working on new regulations to control permissible levels of EM pollution of the frequency spectrum. This work reflects the concern for environmental protection. Radiation hazards also are being regulated through concern for occupational safety. Engineering agencies working for the military must therefore know the legal and regulatory aspects of the EMC and radiation hazards to meet these requirements.

Military specifications on EMC such as MIL-STD-461, -462, and -463 are intended to control and achieve an acceptable figure of merit or quality in the development of new communications equipment. They do not eliminate the need for EMC engineering in facility design. In addition to equipment quality, the frequency selection, nearness to other facilities, and, to some extent, the facility design itself are variables in the interference generation problem. (2) 5-43

3. Correct shielding procedure

A comprehensive approach to shielding equipment from radiofrequency interference (RFI) or TEMPEST involves (a) a building layout to optimize inherent facility shielding conditions, (b) suitable location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components. See Vol 2, SB4, for additional guidance information.

activities

1. Inspecting and diagnosing equipment and parts.
2. Doing complete preventive and unscheduled maintenance.
3. Assembling electronics.
4. Testing electronics.
5. Insuring secure storage of parts and equipment.
6. Maintaining records on parts and equipment.
7. Writing and typing reports: 349s, and equipment historical records.
8. Monitoring CRYPTO sync panel.
9. Notifying contractor on CRYPTO when problems arise.

personnel

1. Two crypto technicians.

equipment *

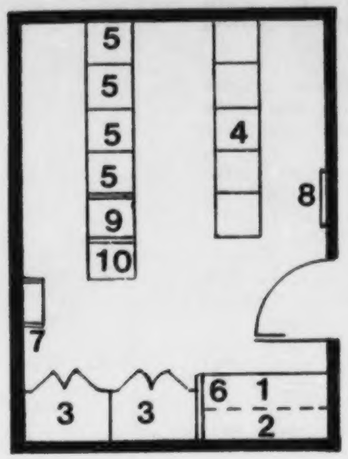
1. Two electronic workbenches with stools.
2. Shelving over workbench for publications manuals.
3. Locked storage cabinets secured to wall for special electronic equipment.
4. Red Patch Bay.
5. Black Patch Bay.
6. Telephone.
7. Filesafe (1) for records.
8. Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Adequate space to accommodate the cryptologic function.	**1.** Approximately 500 square feet are required to provide space for two personnel and the required cryptography equipment.	
2. Security.	**2.** It must be lockable when unstaffed by providing a cipher lock and intrusion alarm system. In addition to physical protection by walls and doors, the ceiling and air-conditioning ducts must be intrusion-proof. For RED/BLACK security, the installation shall conform to MIL-HDBK-232.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Communication lines for emergency operations.	**3.** The telephone system must be coordinated with key lines (pre-designated personnel).	
4. RFI/TEMPEST shielding.	**4.** Shielding is required for electrical and electronic equipment to prevent it from propagating interference and to protect it against interference propagated by other electronic devices (15a)7 The term "TEMPEST" flags the system as one processing National Security related information and establishes the need for additional, site-specific alterations and improvements to the facility.	**4.** See Vol 2, SB4, Grounding, Bonding and Shielding, along with SB7, Security Systems, for more information.
5. EMP/HEMP shielding.	**5.** Shielding is necessary for survivability and uninterrupted functioning when the facility is subjected to EMP and HEMP. Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	**5.** See Vol 2, SB5, EMP/HEMP Protection, for more information.
6. Interior finishes suitable for durability, maintenance, and room function.	**6.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor with a dust-on finish that contains a hardener. See Vol 2, SB2, Interior Construction. Base--Glazed structural units, rubber vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	**6.** See also Vol 2, SB2, Interior Construction and Finishes.

requirements	criteria	commentary
7. Acoustical isolation/attenuation to provide comfort for a nondisruptive environment.	**7.** The walls surrounding the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .90, floor surface at NRC .50.	
8. Adequate lighting.	**8.** Light fixtures should provide an approximate uniform light intensity of 70 footcandles and should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. Fixtures shall also be equipped with integral RF interference filters (GE no. 89G635, Sprague IF-37, or equivalent). The work area shall also be equipped with adjustable task lighting.	
9. Thermal comfort.	**9.** Temperature should be kept at 68°F (heating) and 78°F (cooling). A 5-cubic feet per minute per person outside air ventilation rate should be maintained.	**9.** See also Vol 2, SB2, Communication Station Buildings--Mechanical
10. Electrical power.	**10.** Power should be supplied by a 120/208 electrical service. A 120-volt receptacle should be installed for each workstation at a convenient height and/or for every 10 linear feet of wall. Electrical power must fall within the 10,000- to 500,000-watt range. Frequency levels must be at 50 to 60 hertz ± 5 percent. Provide line filters for RFI on all electrical power lines.	**10.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumption that this facility houses critical equipment and data, which creates a severe strategic fire loss potential.	**11.** Vaulted enclosure walls--2-hour minimum fire-rated construction; shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or to constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area automatic fire detection--Local alarm; automatic Halon 1301 suppression system if cross-zoned or matrix detection is required. Sprinkler and Halon systems are not normally installed in the same areas.	**11.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance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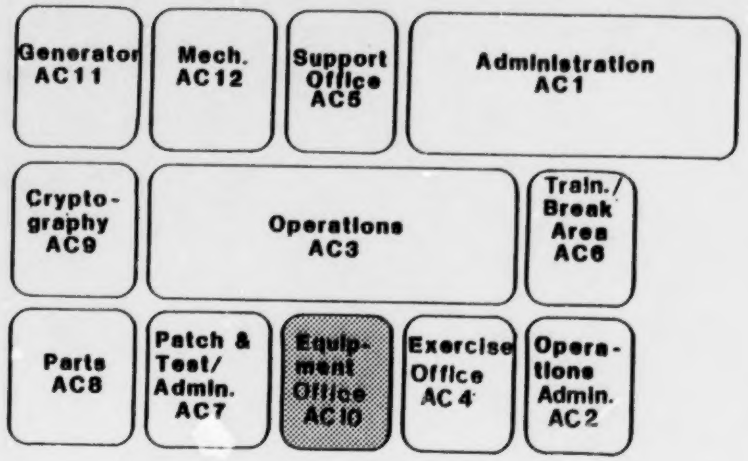
11-- speaker in ceiling

guidance

guidance

guidance

EQUIPMENT AC10


Generator AC11
Mech. AC12
Support Office AC5
Administration AC1
Crypto-graphy AC9
Operations AC3
Train./Break Area AC6
Parts AC8
Patch & Test/Admin. AC7
Equip-ment Office AC10
Exercise Office AC 4
Opera-tions Admin. AC2

function

To allow space for personnel to operate, maintain, monitor, and repair communication equipment.

policy/sop

1. Provide adequate space between equipment rows to allow for opening cabinet doors or sliding out modules for maintenance. (2) 5-20

issues and assumptions

1. Automated recordkeeping

CRTs with hardline printers can streamline paperwork by storing all circuit history files on disk, thus eliminating time-consuming paperwork. This will allow troubleshooting to be done much more rapidly in-house.

activities

1. Isolating fault.
2. Receiving and processing outage reports.
3. Typing report logs.
4. Recording maintenance work.

personnel

1. Shift personnel as required.

equipment *

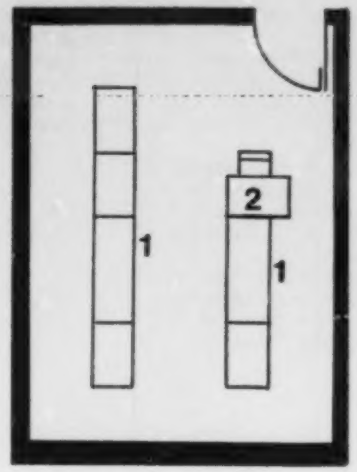
1. Electronic communication equipment.
2. Desk with chair.

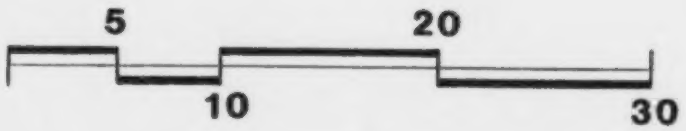
* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for transmission equipment layout.	**1.** Provide approximately 450 square feet in an area 15 x 30 feet to accommodate the transmitter bays.	
2. Enough space to accommodate communication equipment inspection, testing, and storage.	**2.** Allow a 48-inch workspace behind all radio equipment for inspection, testing, and repair.	
3. RFI shielding.	**3.** Electrical and electronic equipment must be shielded to prevent it from propagation interference and to protect it from the effects of interference propagated by other electronic devices. (15a) 7	**3.** See Vol 2, SB4, Grounding, Bonding, and Shielding, along with SB5, EMP/HEMP Protection.
4. Raised floor system.	**4.** Raised or false floors are necessary for proper cooling of the equipment.	**4.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
5. Interior finishes suitable for durability, maintenance, and room function.	**5.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor that has a dust-on finish containing a hardener. See Vol 2, SB2, Interior Construction. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster and acoustic tiles to within four feet of the floor. Ceiling--Acoustic tile.	**5.** See also Vol 2, SB2, Interior Construction and Finishes.
6. Acoustical isolation/attenuation for variable noise levels produced by electrical equipment.	**6.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile is also required to within 4 feet of the floor.	
7. Adequate lighting.	**7.** Ambient: 20 footcandles. Task (testing and inspection): 70 to 100 footcandles.	
8. Environmental control for proper operation of electronic equipment.	**8.** Temperature should be maintained at 73°F (±2°), with 50 percent relative humidity (±5 percent). Filtered air in transmission area. (See MIL-HDBK-411A.)	**8.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
9. Electrical power.	**9.** Provide 120/208 electrical service. Electrical power may fall within the 10,000- to 50,000-watt range. Voltages are required to be 50 to 60 hertz ± 5 percent. Install a 120-volt outlet for every 10 linear feet of wall and as required for coordination with equipment.	**9.** See also Vol 2, SB2, Communication Station Buildings--Electrical.

requirements	criteria	commentary
10. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that would create a severe strategic fire loss potential.	**10.** Vaulted enclosure walls: Shielded, 2-hour (minimum) fire-rated construction. Interior doors in vaulted walls: 1½-hour fire-rated doors; shielded doors and frames. Interior finish: Class A or B only. Automatic fire detection: Local alarm Automatic fire suppression: Water sprinklers Automatic notification/alarm: General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area: Automatic fire detection--local alarm. Automatic Halon 1301 suppression system if cross-zoned or matrix detection is required. Sprinkler and Halon systems usually are not installed in the same areas.	**10.** See Standardized Modules, Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance





guidance

4. Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on a raised floor system for maximum use of cooled air directly through the cabinets. Cooling air at 60°F supplied directly into the transmitters' base will leave at the top at approximately 72°F. Thus, air exiting the equipment is at a more comfortable temperature for personnel working in the space.

7. Equipment area

Fixtures should be arranged above the operating aisles running parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so they will not be obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interefere with access to cable trays or equipment. (23) 12 Portable task lighting (70 to 100 footcandles) also should be supplied in the equipment area.

8. Protection from moisture migration

Operating spaces containing electronic equipment usually require careful temperature and humidity control. Vapor barriers under floor slabs and incorporated into roofing usually can prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided where exterior walls form part of the equipment space. (92) 12.1-13

See also Vol 2, SB2, Special Mechanical.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Lack of adequate cooling contributes as much to failure as does inadequate regulated power. (74) 4-17

Even though certain individual units can be operated outside the limits of the overall specifications, the system's environmental requirements are dictated by its most restrictive unit. The computer's requirements are the major considerations in designing the air-conditioning system. However, good design will also consider personnel comfort. (74) 4-17

guidance

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning as follows: (74) 4-17

- Heat dissipation by the computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity, because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The air changes per hour number between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain conditions required in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because the water vapor can damage the equipment. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Should the air-conditioning requirements not be met, a record is available that shows the extent and duration of the undesirable condition and to indicate if a drying-out period is required. This record may, in some cases, save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-25

- Insure that the air-conditioning installation continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is necessary when humidity limitations are exceeded. The drying-out may be needed if the excess humidity occurs either during actual operation or when the machine is shut down and unattended. The extent and duration of the excess humidity will determine the length of the drying-out period.
- Determine if the environment in the area meets the machines' requirements.

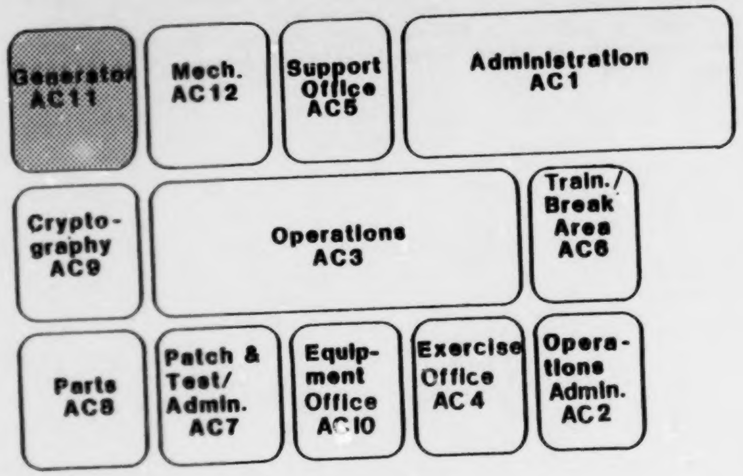
It is desirable that the instrument have a visual or audible signal to indicate when the temperature or humidity in the computer area is nearing maximum limits.

guidance

Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The record usually is located at a representative spot in the room and adjacent to the control devices.

A remote indicating instrument is recommended for monitoring the underfloor air conditions. This is usually a 7-day electric-drive chart and can be the wet and dry bulb or electronic type if a direct reading device is not available. The recording instrument can be located on the wall in the room, in the mechanical equipment room, or at any other location convenient to the building engineer.

GENERATOR AC11



function

Facility generators maintain power to all communication systems when the commercial power fails.

policy/sop

1. Facilities usually will have three generators as a backup power source in the event of commercial power failure:

   - One generator will be online, set for automatic startup
   - Another will be backup to the first, in case of failure
   - A third generator will be considered "in maintenance" condition to be available if the backup generator fails.

   (See MIL-HDBK 411A for specific policies on the various generator classes.)

2. Primary power requirements for a communications facility are determined by the system configuration and include equipment loads (technical power), utility and domestic loads, and provisions for future expansion. The architectural engineering agency is responsible for designing the site primary power system and its distribution. One of the most economical, convenient sources of auxiliary power is the diesel-engine generator. However, an engine-driven generator requires time to start and warm up, causing a delay before taking the load after a power failure. The recommended practice is to use storage batteries to provide power instantly and economically. They are kept fully charged by the primary power source during normal operation and, when failure occurs, they assume the load instantly without interruption to service. Batteries lack the capacity to supply power for a long period of time, so it is necessary to have an auxiliary generator available. (70) 15-11

3. On-station prime power plants are considered only when the local power is either extremely unreliable or prohibitively expensive, when no power is available, or when self-sufficiency is required for survival and reliability in a wartime environment. On-station prime power plants normally use multiple sets of DOD standard family, diesel-engine generator sets for the power source. Other sources (such as wind turbines, thermoelectric generators, fuel cells, gas-turbine generators, steam-turbine generators, and nonstandard diesel-engine generators) can also be used and should be considered when requirements for a wartime DCS dictate. An onstation prime power plant will use a minimum of three engine generator sets with one set online to carry the station load, one set as a standby, and one set as a maintenance spare. A more reliable configuration is to use four or five generator sets with two online in a load-sharing mode, one as a cold standby unit and one or two as maintenance spares. When the station's standby power requirements exceed 70

policy / sop

percent of the total power requirements and the standby power is redundant, a study should be done in accordance with DOD 4270.1-M to determine if it would be more economical to provide a total energy system that produces both electrical and steam power to be used as needed. (1) 31

4. Site personnel efficiency will be improved if it is possible to locate noisy mechanical equipment, like some diesel generators, away in housing separate from working and living areas or if some other type of noise control is provided. Also, care must be taken to insure that fresh air intakes do not catch fumes or odors from sources such as diesel generators. (2) 5-25

5. All onsite power sources (generators) and substations should be located at a point in the station boundary for which security is adequate. Additional guidelines for locating power sources and substations are: (1) 32

   a. The primary onsite power source should be located far enough from the station work areas to insure acceptable noise levels as outlined by the acoustical noise requirements of MIL-STD-1472.

   b. The primary substation should be located for convenient delivery of power from an off-station source and for easy distribution of the power to onsite facilities as required.

   c. Distribution substations should be located as close as possible to the parts of the operating building they serve.

6. Total fuel storage tank capacity should be determined by local replenishment opportunities, but should hold at least a 30-day supply for primary Class A on-station generators per MIL HDBK 411A. Class C generators require a 7-day minimum supply and Class B generators require a 15-day minimum stored fuel supply. The storage tank(s) should be constructed of fiberglass and when practical, installed underground on an incline to prevent sediment accumulation. Provisions should be made for easy filling and removal of water and other sediment. (19) 13.

issues and assumptions

1. Commercial power versus generators

The mission of DCS communication facilities is to provide reliable communications 24 hours per day. Ideally, the power source for the mission equipment should be reliable, well regulated, easily maintained, and free of transients and disturbances. In actual practice, these desirable characteristics are seldom achieved on a long-term basis. Other factors to be considered in the choice of a facility power supply are:

   a. Providing the best possible system for the least amount of money (cost effectiveness).

   b. Standardizing for better cost effectiveness.

   c. Providing easy support (maintainability). (87) Vol 2, 62

Normally, a DCS communications facility will operate from commercial power using local generators for backup. In some areas of the world, however, commercial power may not be available or if it is, it may be so unreliable as to be unusable for the technical load. Such supplies may be satisfactory for the nontechnical load (area lighting, housing, etc.). In such cases, the primary power source should consist of generators located on the facility site. (87) Vol 2, 83

2. Comparison of engine generators

The selection of an engine generator to supply an independent power source (primary and/or standby) depends on several factors. The choice is usually between a diesel and a gasoline engine. Each has properties that determine its suitability for a particular application.

The diesel engine is suitable for either continuous or part-time service. Initial cost is slightly higher than that of a comparable gasoline engine; for certain applications, however, this disadvantage is more than offset by advantages. The diesel engine is extremely rugged, uses less and lower cost fuel, has a long life expectancy, and offers maximal reliability. Reasons for these advantages include (a) diesel fuel has a higher energy content than gasoline or liquid petroleum, (b) diesel engine operating speed is approximately half that of the gasoline engine, and (c) the diesel engine does not require an electrical ignition system. The last two factors account for lower maintenance and overhaul costs for the diesel engine. Engine starting time is comparable for diesel and gasoline engines.

Gasoline engines can be used for continuous power, but are better suited for standby use. As mentioned previously, the gasoline engine has a lower initial cost, but also a shorter life expectancy. It has a higher operating speed, which wears out the engine more rapidly. It uses more and higher operating speeds, which also wear the engine out more rapidly. It uses more and higher cost fuel and is not as reliable as a diesel engine. One reason for poor reliability is that a gasoline engine uses an electrical ignition system which is subject to failure due to dampness, age, and carbon buildup. (70) 14-3

issues and assumptions

3. Level of maintenance performed

If depot level maintenance is required and authorized, an open area, benches, and special tools (torque wrenches) also are required in the generator room. This is especially true at Navy installations, which require more extensive repair onsite.

4. Above-ground versus below-ground oil storage tank

To insure protection from hostile attack, below-ground tanks provide better security for the standby power system; however, above-ground tanks are cleaned, repaired, and maintained more efficiently, effectively, and economically.

5. Sizing generator fuel tanks

Engine generator size depends on the station's power requirements. The fuel tank capacity for these units depends on the site's accessibility and the size of the engine generators. It should not be necessary to refill fuel tanks more than once a month. If inclement weather or undue hardship dictates a longer period of time between refuelings, a larger tank is recommended. The approximate rate of fuel consumption of a diesel-driven generator, in gallons per hour, can be calculated by multiplying the output in kilowatts by 0.136; this calculation will be helpful in determining the size of tank needed. (70) 14-2

activities

1. Starting the on-line generators after commercial power failure.
2. Repairing and maintaining generators.

personnel

1. Two personnel, though not in room continuously.

equipment **

1. One "set" of generators.* (Usually Class C.)
2. Batteries for start-up.
3. Fuel tank with dispensing pump. (Tank capacity varies with size of generators and reliability level of primary commercial power.)

   See MIL-HDBK 411 for the specific capacity in relationship to a class of generators.
4. Alarm panel.
5. Automatic transfer switches.

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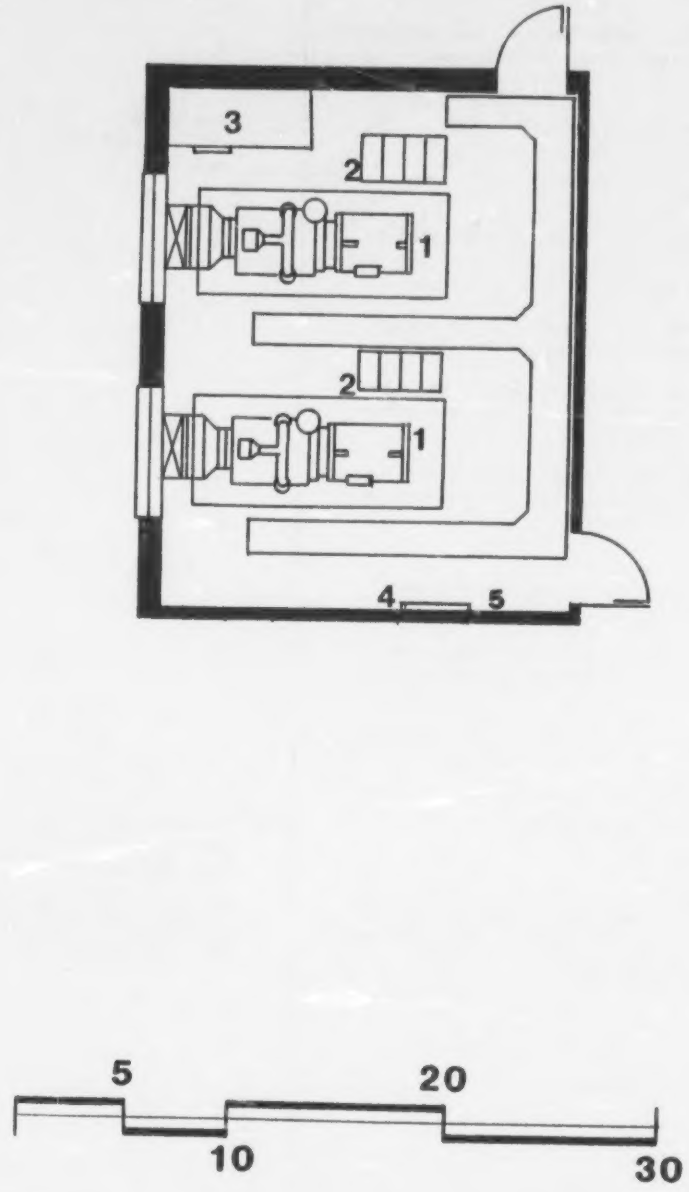
*The number and size of generators will vary among facilities depending on the voltage required to maintain the mission.

** see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for the installation, removal, and repair of standby generators.	1. Space needs vary with power requirements (see guidance drawing). Allow approximately 550 to 600 square feet for two generators.	
2. Interior finishes suitable for durability, maintenance, and room function.	2. Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	2. See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustic isolation for variable noise levels produced by mechanical equipment.	3. Adjacent room walls should limit sound transmission to 40 decibels.	
4. Generator operation indicator and alarms.	4. An alarm and operation indicator panel will be located at the control console area of the operations space.	
5. Emergency lighting.	5. Emergency lighting should be bright enough to allow switch gear operation, instruction reading, and other mission-essential activities.	
6. Environmental control to provide generators' constant supply of make-up air for combustion and cooling.	6. Provide automatically adjusted louver units sized for capacity of generator selected. Exhaust stacks must be caged to prevent bird/animal entry.	
7. Vibration control.	7. The generators must be placed on a concrete pad physically isolated from the main floor.	
8. Design that allows complete removal and exchange of generator units.	8. Air intake/exhaust units should be located and sized to become a "knock-out" panel for removing a complete generator.	
9. Adequate lighting.	9. Use 40 footcandles (ambient). "Slow start" fixtures such as mercury vapor should not be used, nor should fluorescent fixtures.	
10. Thermal comfort.	10. Regulate temperature at 50°F for heating.	10. See also Vol 2, SB2, Communication Station Buildings--Mechanical.
11. Electrical power.	11. Provide 120/208 electrical service. Install 120-volt outlets; at least two duplex receptacles are required at workbench areas and at the appropriate height. Use 240-volt receptacles when required.	11. See also Vol 2, SB2, Communication Station Buildings--Electrical.

guidance



guidance

1. Location

If a standby generator is to operate continuously for instantaneous commercial power backup, the generator room should be located away from all normal operational spaces to isolate the noise.

Clearances--All ducts and other systems installed in the facility as part of the finished structure should be arranged to maintain a 10-foot unobstructed clearance from the floor to the ceiling.

Structural--Isolate the foundations of each generator to prevent transfer of engine vibrations to the building. Floor loading should be designed to accommodate a steady load of the heaviest auxiliary diesel engine generator designed/selected by the contractor. Pad dimensions may exceed the engine dimensions by 25 to 30 percent.

Doors--All single doors should be constructed of steel and should have a minimum dimension of 4.0 by 7.0 feet. The exterior equipment door for the generator room should be double-wing type with minimum dimensions of 6.0 by 7.0 feet. This door should be equipped with a drop-in horizontal bar to secure it from the inside.

Storage tank--When required, provide an underground fuel oil storage tank adjacent to the power/mechanical room. Also provide fuel oil supply and return lines, fill pipe, oil level gage, and alarm conduits. This tank must be equipped with a float switch to activate an alarm indicating a low fuel oil condition.

A single storage tank should be provided for a minimum fuel supply for both the heating boiler and diesel engine generators. MIL HDMB 411A requires Class C generators to reserve a 7-day supply, Class B generators should reserve a 15-day supply, and Class A generators should reserve a 30-day supply. A fiberglass underground tank should be used. A day tank should be provided in the building to supply fuel to both the heating boiler and diesel engine generators. (See also Vol. 2, SB1, Site Planning and Development).

Provide floor trenches in the power/mechanical room for supply and return fuel lines from the exterior fuel oil storage tank and for cable runs from the generator to the transfer switch and main distribution panel. Floor trenches should have 0.25-inch-thick steel plate covers.

guidance

4. Alarm system

Provide a wall-mounted alarm terminal panel in the generator room. The following alarms will be terminated there:

- Generator status
- Commercial power status
- Low fuel oil level (48-hour supply)
- High (80°F) or low (55°F) temperature status in communication equipment and power mechanical room
- Generator start failure.

The termination board or its associated housing should have all alarm terminations identified clearly with permanent marking or labels for future extensions of these connections to a control and fault alarm system. The alarm sensors should incorporate only dry contacts (no voltages) and should use two conductor shielded cables in the circuit runs or in conduit to the consolidated terminal panel noted above.

Provide adequate grounding cable from the building ring ground system, when applicable, to the diesel generator set metal frame and to the underground fuel oil storage tank. See Vol 2, SB4.

6. Environmental control

Generator exhausts should be located such that fumes will not be sucked into other HVAC air intakes. Emergency generators can be located inside the operations building if they are isolated properly from the rest of the structure in terms of fire protection, sound attenuation, and vibration control. (92) 12.1-12

Louvers and Openings

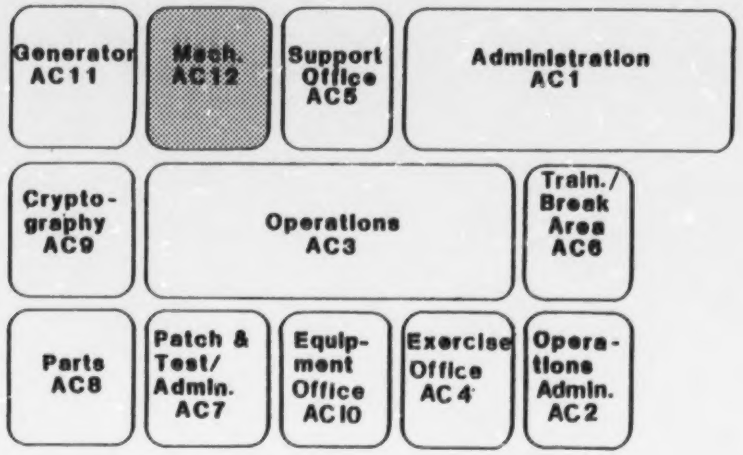
Provide motorized air damper openings in the generator room walls to accommodate diesel engine combustion air requirements. Dampers should automatically activate when generator starts.

Provide security bars on all openings subject to physical intrusion (greater than 7.6 feet in perimeter) such as air intake and exhaust louvers. Their attachment to the structure must be nonremovable from the exterior.

See Vol 2, SB7, for security guidance.

guidance

MECHANICAL AC12


Generator AC11
Mech. AC12
Support Office AC5
Administration AC1
Crypto-graphy AC9
Operations AC3
Train./Break Area AC6
Parts AC8
Patch & Test/ Admin. AC7
Equip-ment Office AC10
Exercise Office AC4
Opera-tions Admin. AC2

function

This module provides space for equipment to supply all the heating, ventilating, and air-conditioning (HVAC) and water requirements for the entire facility. It must also be flexible and spacious enough to accommodate alternative energy sources.

policy/sop

1. It is desirable to provide a separate room for mechanical equipment such as heat exchangers, air-conditioners, and waveguide dehydrators-pressurizers. Heat exchangers must have air intake and exhaust ducts to the outside of the building. The size of these ducts dictates that heat exchangers must be located close to the wall. It must not be overlooked that some types of heat exchangers may require rear access for maintenance. Location of the dehydrating-pressurizing equipment is not critical. However, ease of access for maintenance is desirable and the pressure gages should be readily visible to the maintenance personnel. The air-conditioning equipment location will depend on the specific type provided and whether or not intake and outside exhaust are required. (2) 5-24

issues and assumptions

I. Calculation of space requirements

a. Heating for each area of the facility is commonly provided by an oil-fired hot-water boiler located in the mechanical equipment room. During the heating season, hot water is supplied from the boiler to the various heating, air-conditioning, and domestic hot-water systems. In the summer, domestic hot water is provided by a small oil-fired hot-water heater and the boiler is turned off. This arrangement will add to boiler efficiency and energy conservation.

b. Provisions will be made in the mechanical equipment rooms to allow for removal of tubes from boilers and chillers as well as the removal of coils and filters from air handling units for maintenance and replacement. All equipment will be located to allow easy access for maintenance and servicing.

c. Usage will be 24 hours per day, 7 days per week. No special provisions for peak usage are required.

activities

1. Maintaining, controlling, and inspecting mechanical equipment.

personnel

equipment *

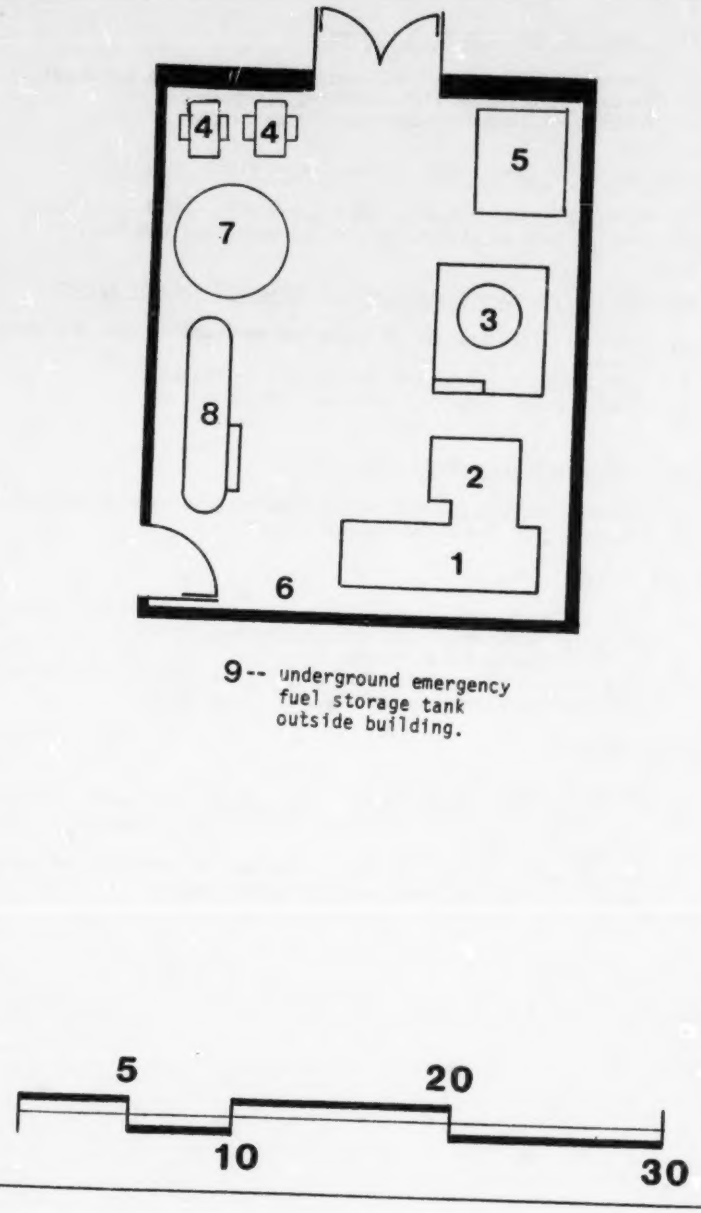
1. Chiller.
2. Condenser.
3. Compressor.
4. Water pumps.
5. Boiler.
6. Electrical switchboard.
7. Emergency water supply tank.
8. Day fuel tank.
9. Emergency fuel storage tank. (Underground--see Vol 2, SB8.)

Note: Alternative energy sources may vary and alter equipment needs. See Vol 2, SB6--AES, for information.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate the mechanical equipment requirements associated with the facility's environmental maintenance.	**1.** The ratio of mechanical equipment space to the total facility interior floor space varies from 7 percent for small facilities to about 4 percent for large facilities. (See "Issues" box.)	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation for variable noise levels produced by mechanical equipment.	**3.** Adjacent room walls should limit sound transmission to 40 decibels.	
4. Information display.	**4.** The operating instructions, preventive maintenance schedule, wiring and control diagrams, and detailed control sequence should be framed under glass or plastic and posted for easy reference.	
5. Water supply and sanitary sewer.	**5.** The water supply and sanitary sewer for this facility, will be connected to the existing post systems or as prescribed for foreign locations. Provide an emergency water supply tank of 20-gallon per capita capacity for 7 days. Water must be refreshed periodically. See Vol 2, SB8, Survivability Protection.	
6. Adequate lighting.	**6.** Provide 40-footcandle fluorescent fixtures (ambient).	
7. Thermal comfort.	**7.** 50 to 68°F range (winter heating), except for batteries, which must be kept at 60 to 68°F.	**7.** See also Vol 2, SB2--Communication Station Buildings--Mechanical.
8. Electrical power.	**8.** Commercial electrical service used in the building will be site-specific. Availability depends on the host country if OCONUS. An outdoor transformer can be installed for the mechanical space in terms of general building power. Install 120-volt receptacles as needed. Electrical power must fall within the 10,000- to 500,000-watt range. Frequency levels should be at 50 to 60 hertz ± 5 percent.	**8.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
9. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**9.** Interior enclosure walls--1-hour fire-rated construction. Interior doors--20-minute fire-rated. Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**9.** See Standardized Modules--Building Design Principles, Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Storage tank

A single storage tank should be provided for a minimum 15-day supply for both the heating boiler and diesel engine generators. A fiberglass underground tank should be used. A day tank should be provided in the building to supply fuel to both the heating boiler and diesel engine generators. This tank must be equipped with a float switch to activate an alarm indicating a low fuel oil condition.

Doors--The exterior equipment doors should be steel, double swing type with steel frame. The inner opening should be at minimum 6 feet wide by 7 feet high. The equipment door should be equipped with interior locking panic hardware.

Both the exterior personnel and equipment door hinges must be welded to prevent removal of hinge pins if pivots and pins are on the outside.

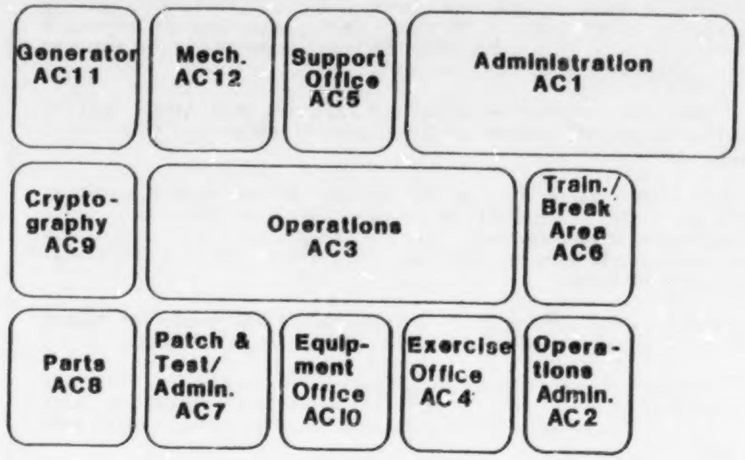
Provide security bars on all openings greater than 7.6 feet at the perimeter and subject to physical intrusion (for example, air intake and exhaust louvers). Their attachment to the structure must be nonremovable from the exterior. See Vol 2, SB7, for additional security guidance.

Structural--The minimum floor design load is 150 pounds per square foot. A clear ceiling height of 10 feet should be provided.

Mechanical equipment should be isolated to minimize vibrations. This can be done by mechanically isolating each individual system on concrete pads separate from the mechanical room floor.

Heat exchangers must be provided with air intake and exhaust ducts to the outside of the building. The size of these ducts means the heat exchangers must be located close to the wall. However, some types of heat exchangers require rear access for maintenance. Location of dehydration pressurization equipment is not critical, but ease of access for maintenance is desirable. Pressure gages should be readily visible to maintenance personnel. Location of the air-conditioning equipment depends on the specific type provided and whether intake and exhaust to the building's outside are required.
(2) 5-25

STANDARDIZED MODULES AC13


Generator AC11
Mech. AC12
Support Office AC5
Administration AC1
Crypto-graphy AC9
Operations AC3
Train./Break Area AC6
Parts AC8
Patch & Test/ Admin. AC7
Equip-ment Office AC10
Exercise Office AC 4
Opera-tions Admin. AC2

building design principles

1. Efficiency of operational functions

a. Communication equipment aligned for surveillance and access.
b. On-the-job training with operating equipment.
c. Interaction of operational support activities.

2. Integration of parts/maintenance modules with operations

a. Parts/maintenance modules contiguous with operations spaces.
b. Loading dock accessibility for equipment and supplies.

3. Accessibility of administrative and personnel support spaces

a. Administration transition space between public areas and secure spaces.
b. Efficiency of integrated administrative spaces.
c. Change of environment for on-duty personnel.

4. Facility security/survivability

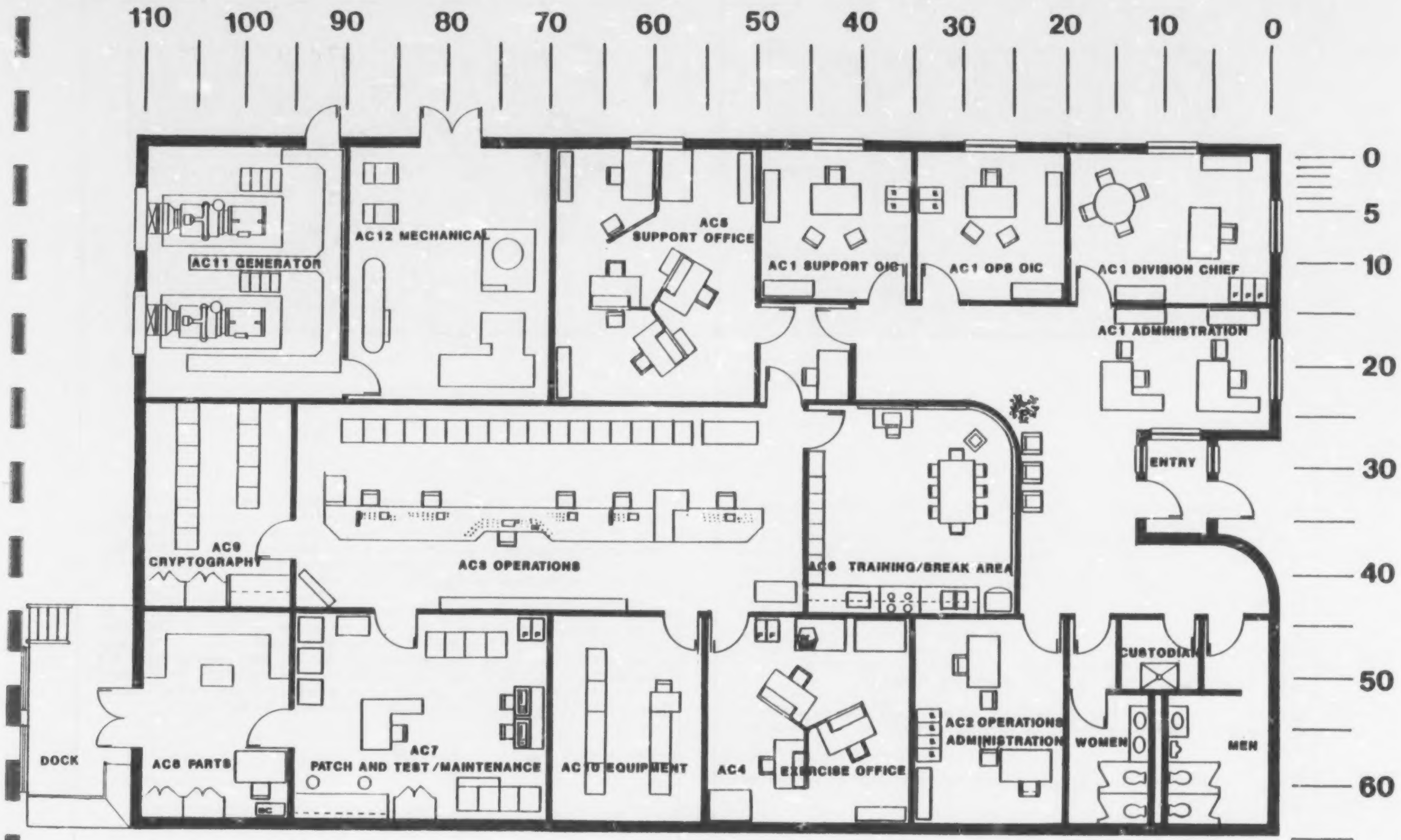
a. Required vault construction for communication system equipment.
b. Protection of the communication signal.

5. Fire protection

a. Fire protection classifications: occupancy, hazard of contents, sprinkler protection, and construction/materials.
b. Building separation distances.
c. Fire protection systems: automatic fire suppression, automatic notification/alarm, and automatic fire detection.

6. Life safety

a. Occupant load determination.
b. Protected exit conditions: exit capacities, number of exits, exit travel distances, and means of exit arrangement.
c. Allowable interior finishes.
d. Egress path identification: illumination of means of egress, emergency lighting, and means of egress marking.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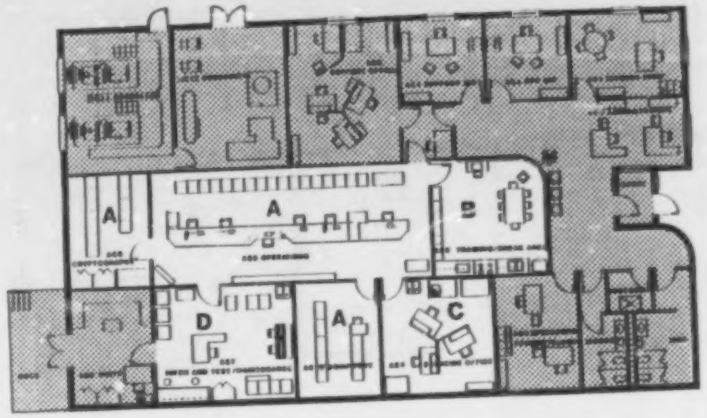
AC11 GENERATOR
AC12 MECHANICAL
AC5 SUPPORT OFFICE
AC1 SUPPORT OIC
AC1 OPS OIC
AC1 DIVISION CHIEF
AC1 ADMINISTRATION
ENTRY
AC9 CRYPTOGRAPHY
AC3 OPERATIONS
AC6 TRAINING/BREAK AREA
DOCK
AC8 PARTS
SC
AC7 PATCH AND TEST/MAINTENANCE
AC10 EQUIPMENT
AC4 EXERCISE OFFICE
AC2 OPERATIONS ADMINISTRATION
WOMEN
CUSTODIAN
MEN

guidance 1. Efficiency of Operational Functions



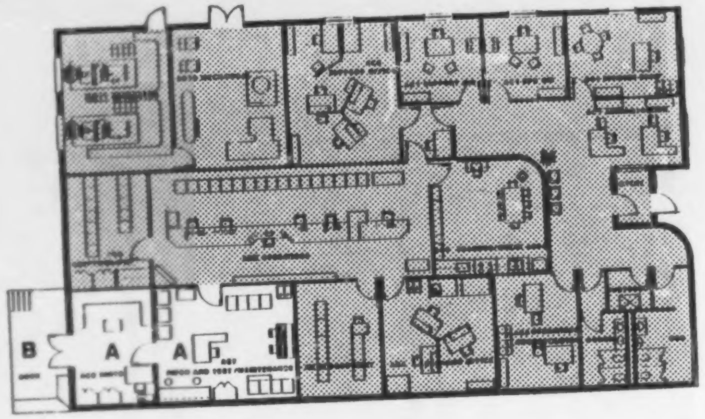
A. Equipment should be aligned in parallel rows within the operations modules for ease in visual surveillance and to provide direct access to all critical equipment. Multiple consoles should be adjacent to each other so that limited personnel can monitor them efficiently at one central location. Tables for audiovisual training aids should be available in operations modules so that personnel can train on-the-job during regular watch periods.

B. To further enhance the effectiveness of on-the-job training, instruction can be done in small groups of four or five in a training room for hands-on experience with communications equipment. This requires a close relationship with the operations module.

C. Additional building modules with a close functional relationship to operations activities should be located adjacent to the operations module.

D. See patch and test module information in section PT of this volume.

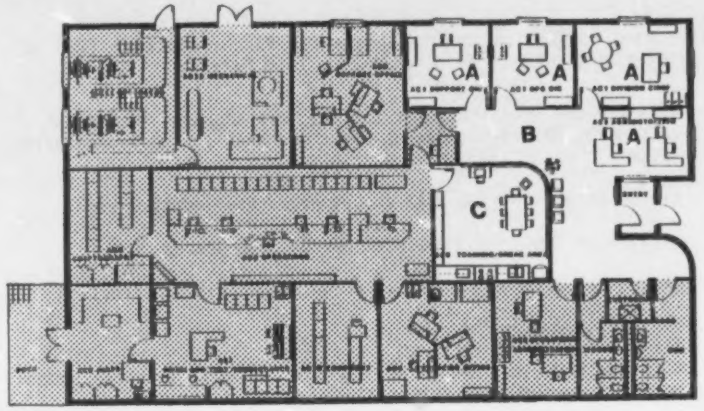
guidance 2. Integration of Parts/Maint. Modules with Ops.



A. Parts and maintenance modules should be well integrated and contiguous with the operations spaces to optimize efficiency and minimize circulation. The secure door between the operations and the maintenance/parts spaces is used only as a fire exit and to bring communication equipment in from and out to the loading dock. This door should have opening hardware only on the secure side.

B. Parts and maintenance from modules must be located within an organizational context such that deliveries can be made to the total building in a direct and secure process at a loading dock. The large communication equipment can be moved in and out more easily using the loading dock. (Also, in multistory communication buildings, an elevator should be located adjacent to the parts module for safe vertical movement of large communication equipment throughout the building.)

guidance 3. Efficiency and Accessibility of Admin. Spaces

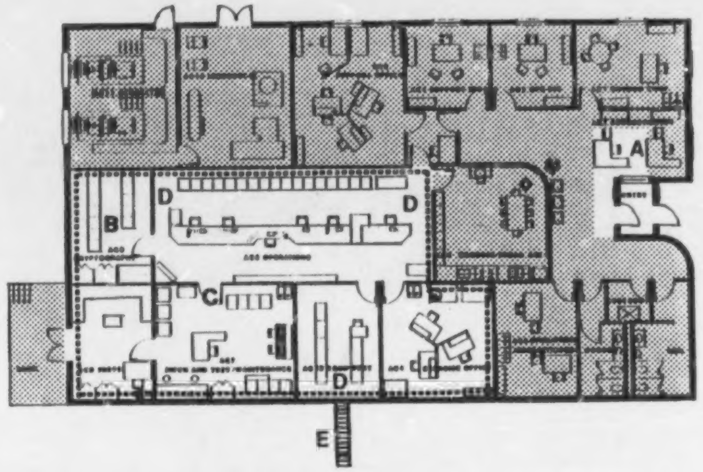


A Administration modules must be easily accessible to the public to minimize circulation and to prevent visitor interference with facility operations. The administration modules should provide a buffer and transition space between the exterior and interior secure spaces. Also, public corridors in the administration area should contain military unit logos and other display panels that relate to the "esprit de corps" and unit integrity of the communication station.

B Administration spaces' integrated relationship will improve efficiency by minimizing public and administrative circulation and by producing a group adjacency to shared conference areas, secretaries, and waiting areas.

C The intense activities inside the DCS facility tend to generate mental fatigue among personnel. It is therefore necessary to create a change of environment for on-duty personnel to provide a break from the "hard surface" equipment room and work areas. The personnel support module should be directly adjacent to the operations room, but isolated acoustically and visually.

guidance 4. Facility Security/Survivability



A Security modules should be located to provide an overview for entry verification of visiting personnel. Additionally this module must be easily accessible to building occupants to facilitate efficient storage and distribution of weapons for personnel.

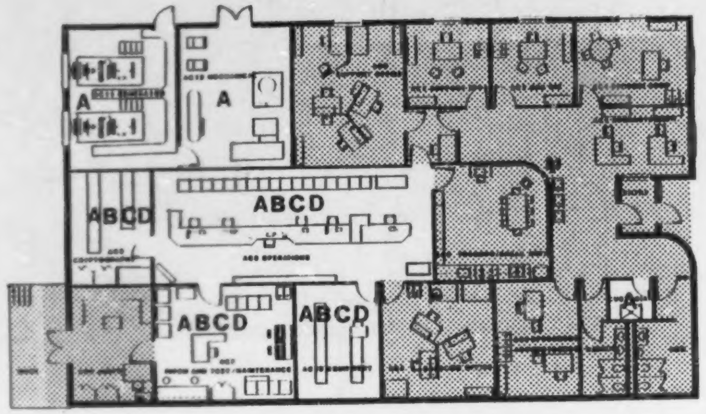
B "Message" security is achieved by minimizing circulation between operations and cryptography modules, confining the modules to controlled areas, and providing disposal techniques to be performed or controlled by authorized personnel.

C Required doors from other interior modules or from the outside that open into secure areas should have opening hardware only on the secure side.

D Conventional Class A vault construction is required for all spaces containing the communication system equipment--for example, operations, equipment, and tech control. Therefore, efficient construction methods and future building flexibility requirements can be met by locating these spaces in a contiguous relationship. These spaces usually require vault-type construction for a combination of four requirements: (1) HEMP protection, (2) TEMPEST shielding, (3) building intrusion resistance, and (4) fire protection. (See SB7, Security Systems--guidance for building security construction of Zone 4, Section 5b in Vol 2).

E Communication facilities require waveguides in transporting the communications signal to and from the transmission/receiving equipment antennas. It is therefore necessary that the transmission/receiving module be located at a minimal distance from the antennas. In addition, waveguides must be physically protected to insure the facility's ability to perform its mission.

guidance 5. Fire Protection



Occupancy classifications: Business (NFPA); B-2 (UBC)

Hazard of contents classification: Ordinary hazard

Sprinkler protection classification: Ordinary hazard--group 2.

Construction classifications/materials for fire protection (See Vol 2, the first figure in SB3, Fire Protection/Life Safety)

A Type II--One-Hour (UBC) for battery, cryptography (RED/BLACK),* custodian, generator, operations,* mechanical, and transmission spaces:

All construction elements.......1-hour rated construction

Type II--N (UBC) for remainder of building spaces

All construction elements.......Noncombustible construction

Building Separation

Site-specific information is required. Comply with the second figure in Vol 2, SB3, Fire Protection/Life Safety.

Interior finishes

See Guidance/Life Safety, Vol 2.

Fire protection systems

Automatic fire suppression

A water sprinkler system shall be provided throughout the entire facility.

B A Halon 1301 or carbon dioxide system shall be provided under raised floor areas containing nonmetallic, sheathed, exposed cables when the space under the raised floor is used as an air plenum.

Automatic notification/alarm

A general alarm must be activated by the automatic sprinkler system.

C Local alarms are required to sound only in the designated spaces; they are activated by smoke detectors.

Automatic fire detection

D Smoke detectors are required to activate local alarms only in the designated spaces. In rooms containing raised floor areas, smoke detectors shall be located under the raised floor.

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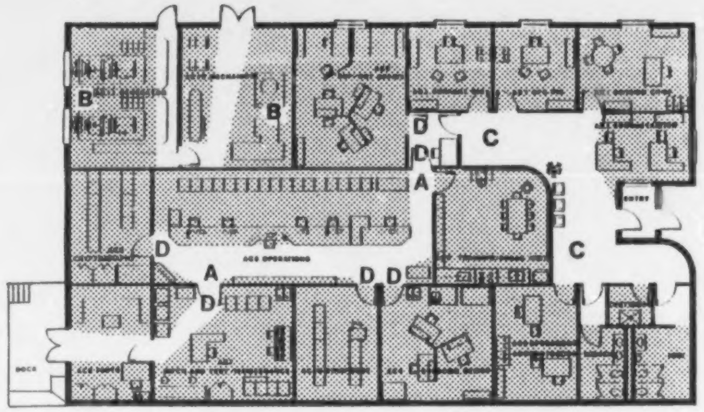
*See Vol 2, SB7, Security, for vault construction requirements that may be more stringent than those imposed by fire protection requirements.



OCCUPANT LOAD FOR DETERMINEING EXIT REQUIREMENTS.

Occupant load factor: 100 square feet per person based on gross floor area (Business Occupancy-NFPA)

Occupant load (total facility) $= \frac{7070 \text{ sq ft}}{100} = 71$ persons

Occupant load (vaulted area) $= \frac{2800 \text{ sq ft}}{100} = 28$ persons

Occupant load (admin/support) $= \frac{1720 \text{ sq ft}}{100} = 17$ persons

Exit capacities

Corridors--100 persons per unit of exit width for travel in either direction. The minimum width of any exit access corridor or passageway shall be 44 inches in the clear.

Doors--100 persons per unit of exit width (a 3-foot door provides 1.5 units of exit width, providing an exit capacity for 150 persons).

Number of exits

No less than two exits shall be accessible from every part of every floor. One exit is permitted when the room or area has: (1) a total occupant load of less than 100 persons, (2) direct exit to an open area outside the building at the ground level, and (3) a total travel distance on the same level of not over 100 feet. (If stairs are involved, they shall be no more than 15 feet in height and shall be provided with complete enclosures to separate the stairs from any other part of the building.)

Exit travel distances

Required exits shall be located to allow access without passage through areas that may be locked. No dead end corridor shall exceed 50 feet. Travel distance to exits shall be no more than 300 feet when the building is protected throughout by an approved automatic sprinkler system.

Arrangement of means of egress

Exit access and travel routes to exits are shown in the plan.

A Exit doors in vaulted areas that contain communications equipment are secured and permit egress out only. Exit access routes through vaulted areas from spaces outside the vaulted area are not permitted for security reasons.

B Two means of egress shall be provided from higher hazard areas, including mechanical and generator spaces. Exit access from any other space may not pass through the mechanical or generator spaces (see exit marking). For security, when mechanical or generator spaces have exit access routes through interior spaces, exit access doors from these spaces, when opened, shall sound an alarm and transmit a signal to the annunciator panel in the security space. Access for normal maintenance in mechanical and generator spaces shall be through the exterior doors.

Interior finishes

C Interior finish in exit access corridors shall be Class A only.

Interior finish in the remainder of the building shall be Class A or B only.

Means of egress lighting

Exits and exit access, including stairs, aisles, corridors, and passageways leading to an exit, shall be lighted continuously during times when the conditions of occupancy require means of egress to be available. Lighting should be no less than 1 foot-candle measured at the floor.

Emergency lighting

Emergency lighting shall be provided in windowless buildings for designated aisles, corridors, and passageways leading to an exit. Emergency lighting shall stay at least 1 footcandle throughout the means of egress for 1.5 hours in the event of normal lighting failure.

Marking the means of egress

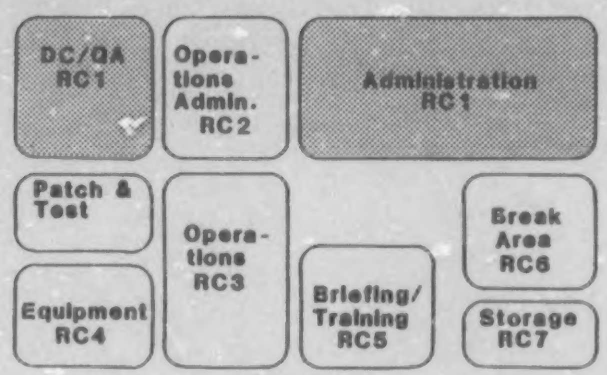
Exits shall be marked by an approved sign readily visible from any direction of exit access. Signs shall be placed such that no point in the exit access is more than 100 feet from the nearest visible sign.

D Doors located or arranged so that they are likely to be mistaken for exits shall be identified by a sign reading "NOT AN EXIT."

Regional Communication Operation Center [RC]

Regional Communication Operation Center RC-1
RC1 Administration RC-2
RC2 Operations Administration RC-6
RC3 Operations RC-12
RC4 Equipment RC-18
RC5 Briefing/Training RC-24
RC6 Personnel Support/Break Area RC-28
RC7 Storage RC-32
RC8 Standardized Modules RC-36

ADMINISTRATION RC1


DC/QA
RC1
Opera-
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RC2
Administration
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Patch &
Test
Opera-
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RC3
Break
Area
RC6
Briefing/
Training
RC5
Storage
RC7
Equipment
RC4

function

To establish and maintain the station administrative processing of personnel records. To implement written and verbal SOP directives from chain of command orders, host agency regulations, and DCA policy for DCS. To provide a buffer and transition space between the outside and secure interior spaces.

policy/sop

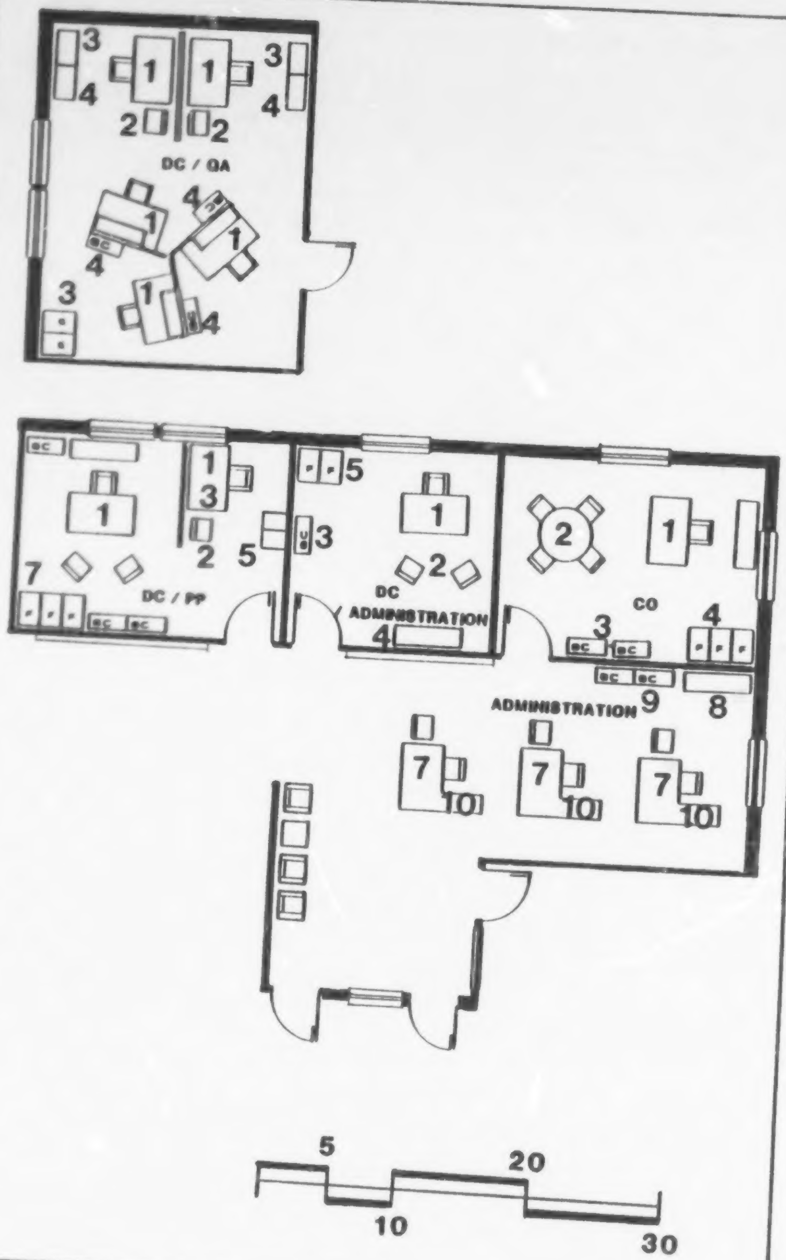
issues and assumptions

activities	personnel	equipment *
1. Distributing directives, orders, and policy statements, both written and verbal.	1. Commanding officer.	**1.** Desk with chair (enclosed unit). **2.** Two side chairs and a conference table with four chairs. **3.** Bookshelves--20 linear feet. **4.** Three files, five drawers each.
1. Initiating evaluations of equipment capabilities for expansion of system communication service to customers. 2. Managing operations function.	1. Division chief--quality assurance, with two technical controllers and two electrical engineers.	Each workstation **1.** Desk with chair. **2.** One side chair. **3.** One file drawer. **4.** Bookshelves--8 linear feet. (All five workstations should be in one space with partitions.
1. Planning for exercises and contingencies.	1. Division chief--plans and programs, with one electrical engineer.	Each workstation **1.** Desk with chair. **2.** One side chair. **3.** Typewriter on stand. **4.** Two tables (30 by 40 inches), one for CRT terminal and one for printer. **5.** Two cabinets (24 by 48 inches), with shelves for tapes, cards and printouts. **6.** Status board (4 by 8 feet wall-mounted). **7.** Three files, five drawers each.
1. Communicating operations and service functions.	1. Division chief--administrative, with one secretary and two clerks.	Division chief workstations **1.** Desk with a chair (enclosed unit). **2.** Two side chairs. **3.** Bookshelves--16 linear feet. **4.** Credenza. **5.** Two files, five drawers each.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the administrative function.	1. For enclosed offices, provide 150 to 300 square feet. Open area workstations require 100 square feet per person.	
2. Interior finishes suitable for durability, maintenance, and room function.	2. Floor--Carpet. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	2. See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	3. The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	3. See reference 201, page 3-4, Table 3-2.
4. Adequate lighting.	4. Provide 80 footcandles for task lighting at work surfaces with 40 footcandles for the ambient level. Surface reflectances should be: • Ceilings--80 to 90 percent • Walls--40 to 60 percent • Floor--20 to 40 percent.	4. For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for the occupant.	5. Maintain temperature at 68°F (heating), 78°F (cooling), with 5 cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	
6. Electrical power.	6. Provide 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	6. See also Vol 2, SB2, Communication Station Buildings--Electrical
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	7. Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppresion--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunicator panel and local fire department or constantly staffed station outside the facility.	7. See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location

Windows to the outside are recommended for CONUS facilities on secure sites, such as military installations. OCONUS facilities usually should have a minimum of windows to limit opportunities for forced entry.

Activity subspaces

- Enclosed offices
- Workstations
- Filing area
- Reception.

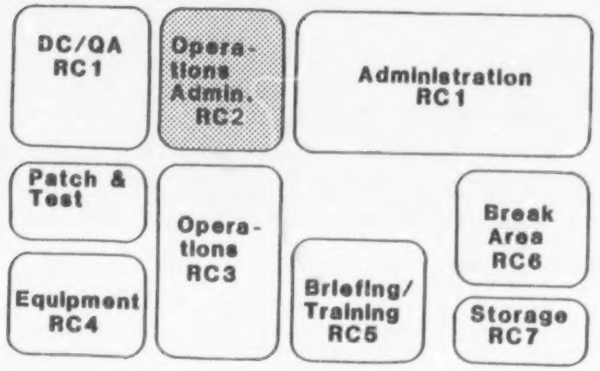
3. Acoustical and visual privacy

Divider partitions between workstations ,should be 60 inches high (± 4 inches) to provide visual privacy while occupants are seated--and yet should not be confining. Circulation paths around workstations should minimize disturbances to other workstations.

6. Electrical power

Workstation divider partitions can be tackboard surfaces to display maps, job examples, service equipment, and other information. Floor-to-ceiling poles are recommended to distribute electrical and communication lines to workstation modules. This eliminates floor wires at circulation paths and allows future module modifications at minimal cost.

OPERATIONS ADMINISTRATION RC2


DC/QA RC1
Operations Admin. RC2
Administration RC1
Patch & Test
Operations RC3
Break Area RC6
Equipment RC4
Briefing/Training RC5
Storage RC7

function

To provide space that specifically supports operations.

To establish and maintain the station administrative processing of personnel records. To implement written and verbal SOP directives from chain of command orders, host agency regulations, and DCA policy for DCS. To provide a buffer and transition space between the outdoors and secure interior spaces.

policy/sop

issues and assumptions

1. Enclosed office versus open area workstation

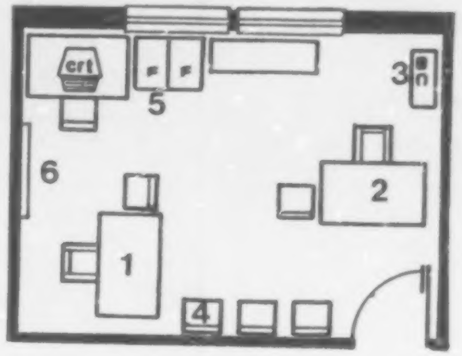
Noncommissioned officers in charge (NCOIC) and their assistants usually occupy an office workstation in the operations room itself. This makes their work more difficult, however, due to high noise and activity levels. If an enclosed office is provided, a view window to the console area must be installed.

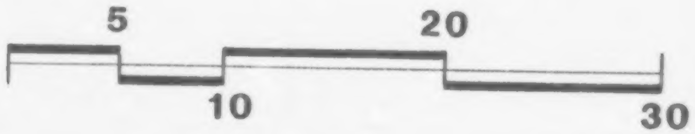
activities	personnel	equipment *
Officers in charge 1. Distributing directives, orders and policy statements, both written and verbal, to shift supervisors. 2. Initiating evaluation of equipment capabilities. 3. Developing personnel training plans and equipment evaluations. 4. Conferring with personnel (one-to-one). 5. Writing/typing reports. 6. Communicating operations and service functions. 7. Managing of operations function.	1. NCOIC and chief in charge. 2. Operations NCOIC.	**1.** One NCOIC workstation: desk with chair in open area (or with dividers), one side chair. **2.** Operations NCOIC workstations: o Desk with chair in open area (or with dividers). o Side chair. **3.** Bookshelves--20 linear feet. **4.** Additional seating. **5.** Filesafe. **6.** Scheduling board or multiboard (4 by 8 feet). * see "guidance" box for example layout of all equipment listed.
Clerical 1. Typing, receiving, and coordinating command/control processes for NCOIC. 2. Filing and posting operations and personnel documents. 3. Providing a courier service for paperwork.	1. One E-2 clerk.	**7.** Clerk workstation: desk with a chair (open area). **8.** Two files, five drawers each. **9.** Bookshelves--45 linear feet. **10.** Typewriter(s)/word processor(s). **11.** Operational voice intercom control.

requirements	criteria	commentary
1. Enough space to accommodate the equipment and furniture associated with the administrative function.	**1.** Provide administrative space for two supervisors with the required desks/chairs, bookcases, and file cabinets; this would be about 300 square feet for two persons, including 60 square feet for a terminal workstation.	
2. Visual contact from offices to the operations floor to provide management with better opportunities to optimize personnel effectiveness.	**2.** Locate the administrative office space adjacent to the operations center console.	
3. Communication lines (outside and inside) for emergency operations and internal interaction between offices and operations floor.	**3.** Coordinate telephone and intercom needs with the installation.	
4. Interior finishes suitable for durability, maintenance, and room function.	**4.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**4.** See also Vol 2, "Site and Building Information," SB2, Interior Construction and Finishes.
5. Aoucstical isolation and attenuation for a nondisruptive environment.	**5.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .90, floor surface at NRC .50, and divider partitions (if used) at .85.	
6. Adequate lighting.	**6.** Use artificial lighting or natural if present. By quantitative and qualitative evaluation, provide: 20 to 30 footcandles general lighting 60 to 80 footcandles task lighting. Surface reflectances: Ceiling--80 to 90 percent Walls--40 to 60 percent Floors--20 to 40 percent.	**6.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical Lighting.
7. Thermal comfort.	**7.** Regulate temperature at 68°F (heating), 78°F (cooling), with a 5-cubic feet per minute per person outside air ventilation rate.	**7.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
8. Electrical power.	**8.** Install 120/208 electrical service. Receptacles (120-volt) should be located for convenience at each workstation and workbench at a suitable height for every 10 linear feet of wall. Electrical power must fall within the 10,000- to 500,000-watt range. Frequency levels should be at 50 to 60 hertz ± 5 percent.	**8.** See also Vol 2, SB2, Communication Station Buildings--Electrical.

requirements	criteria	commentary
9. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe fire loss potential.	**9.** Interior finish--Class A or B only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**9.** See Vol 2, Standardized Modules--Building Design Principles, and SB3, Fire Protection/Life Safety, for more information.

guidance





guidance

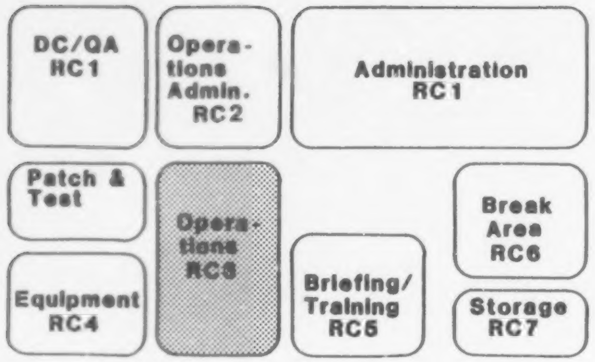
6. Work Area:

Light fixtures providing a uniform light intensity should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. The work area should also be provided with adjustable task lighting.

guidance

guidance

OPERATIONS RC3



function

To provide space for the interface function between DCS' various transmission and switch elements. Specifically, personnel and equipment monitor the DCS links and stations for AUTOVON, AUTODIN, TROPO.SC., LOS, and SatCom units. The operations room allows personnel to operate, maintain, monitor, and repair communication equipment optimally.

policy/sop

1. The Regional Control facility includes the physical, electrical, and manpower capabilities needed to provide (a) technical direction, (b) coordination, (c) technical supervision of transmission media and equipment, (d) quality control, (e) communications service restoral, and (f) status reporting for the various elements of the communication system.

2. In determining the layout when encrypted signals bearing classified information will be present or processed, the specialized installation guidance in MIL-HDBK-232(C) must be consulted. Another major consideration is the access necessary for installation, maintenance, and operation. This would include provision of adequate space between equipment rows to allow for opening cabinet doors or sliding out modules for maintenance. (2) 5-20

3. Other equipment layout considerations include minimizing interbay cabling runs, providing for future expansion, and providing easy access for maintenance and operational convenience. Equipment of the same type or with similar function usually is grouped together except when impractical due to size and/or specific station requirements. (2) 5-20

4. Equipment should be grouped properly according to function and interoperation. Care should be taken when arranging meters, test equipment, jackfields, indicating lights, etc, to insure they are placed at the approximate eye level, thus allowing more rapid, convenient use. Equipment should not be mounted at the bottom of a bay if the equipment can be easily damaged or if its size and shape will interfere with power boxes or other hardware nearby.

5. The station's operational plan must be studied when placing each component or rack assembly to determine the communication circuit requirements. In small stations, it is recommended that the equipment be placed with enough space in between to accommodate a normal floor traffic pattern. However, this type layout usually will not be suitable in stations that have much equipment. In the large station, the most practical layout usually is one in which the equipment is aligned in bays across the width of the room with enough space between bays to permit free access to each rack assembly. (2) 5-22

issues and assumptions

1. Automated recordkeeping

CRTs with hardline printers can streamline paperwork by storing all circuit history files on disk, eliminating time-consuming paperwork. This will allow rapid in-house troubleshooting.

2. Electromagnetic compatibility (2) 5-43

Electromagnetic compatibility (EMC) is a complex subject, with specialists often needed to perform an EMC study to insure that the equipment or equipment layout produces no interferences or radiation hazard.

New DOD regulations control permissible levels of electromagnetic pollution of the frequency spectrum in an effort to protect the environment. Radiation hazards also are being regulated through concern for occupational safety. Engineering agencies under contract with DOD must understand the legal and regulatory aspects of EMC and radiation hazard to meet these requirements.

Military specifications on EMC, such as MIL-STD-461, 462, and 463, are intended to control and achieve an acceptable figure of merit or quality in the development of new communications equipment. They do not eliminate the need for EMC engineering in facility design. In addition to equipment quality, frequency selection, nearness to other facilities and, to some extent, the facility design itself are variables in the interference generation problem. (2) 5-43

3. Determining the correct shielding procedure

A comprehensive approach to shielding equipment from RFI or TEMPEST involves (a) a building layout to optimize inherent facility shielding features, (b) appropriate location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components.

See Vol 2, SB4 for additional guidance.

activities

1. Sending link and station outage messages.
2. Supervising controllers.
3. Typing reports.
4. Isolating faults.
5. Conducting patch and test work.
6. Training personnel.

personnel

1. Noncommissioned officer, technical controllers.

equipment *

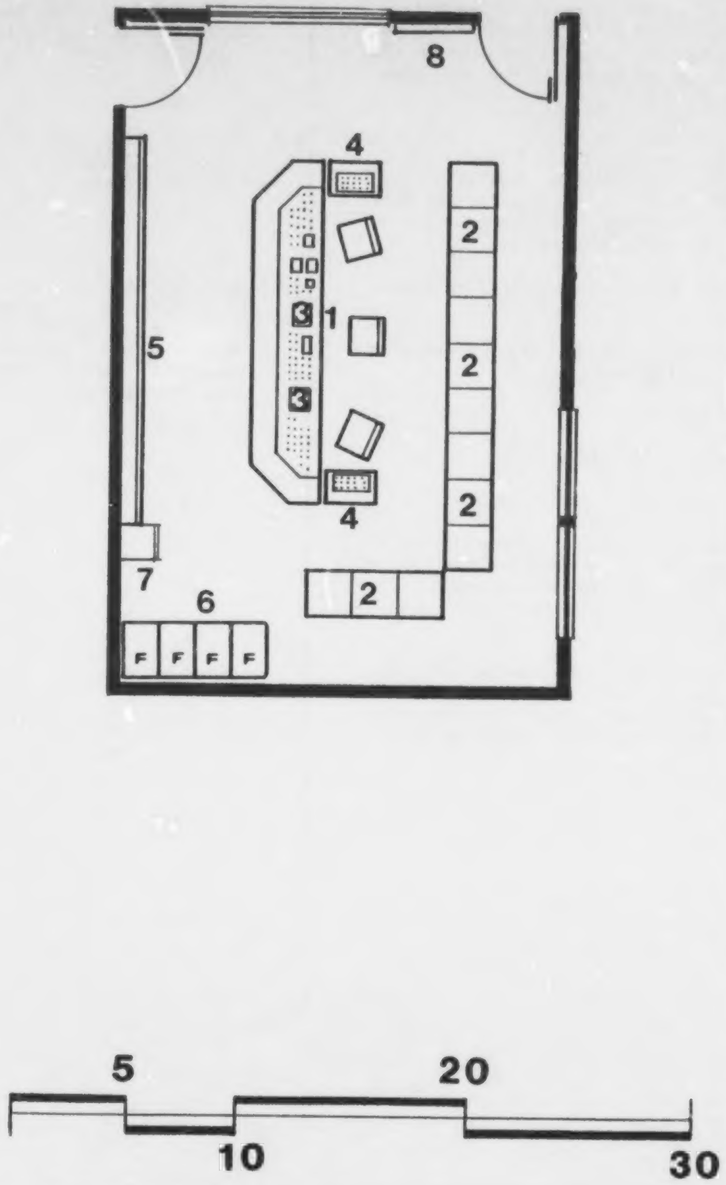
1. Monitoring console; desk unit with chair.
2. Teletypes (12).
3. Telephones.
4. Tables.
5. Book shelving for manuals (20 linear feet).
6. Four file cabinets, four drawers each.
7. Filesafe for classified information, five drawers.
8. Mapboard of system stations and links.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Adequate space for the operation and monitoring of communications-electronics (C-E) equipment. Spatial requirements must allow for proper spacing between equipment to facilitate easy maintenance.	**1.** Varies due to extent of communication equipment designed. See layout in Guidance for 600 square feet design.	
2. A secure environment for C-E equipment.	**2.** The operations room must be lockable when unstaffed and must be supplied with an intrusion alarm system. The operations console should be fitted with alarms for intrusion, power failure, and generator status. Covers should be provided on overhead rods for rapid sanitizing of applicable equipment.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Signal shielding.	**3.** See Vol 2, SB4--Grounding, Bonding and Shielding along with SB7--Security Systems for more information.	
4. EMP/HEMP shielding.	**4.** Shielding is necessary for survivability and uninterrupted functioning when the facility is subjected to EM pulse (EMP) and high-altitude EM pulse (HEMP). Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	**4.** See Vol 2, SB5, EMP/HEMP Protection, for more information.
5. Raised floor system.	**5.** Raised or false floors are necessary for proper cooling of the equipment.	**5.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
6. Interior finishes suitable for durability, maintenance, and room function.	**6.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor with a dust-on finish that contains a hardener. See Vol 2, SB2--Interior Construction. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Wall--Paint over concrete, gypsum board, or plaster and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	**6.** See also Vol 2, SB2, Interior Construction and Finishes.
7. Acoustical isolation attenuation for variable noise levels produced by electronic equipment.	**7.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile is also required to within 4 feet of the floor.	
8. Adequate lighting.	**8.** Lighting shall be specially engineered. Low levels of lighting may be required to permit observation of luminous panels without reflected glare or undesirable contrasts in brightness. Separately controlled luminaires shall be provided for normally lighted operations and for cleaning, with an ambient level of 70 footcandles from fluorescent fixtures.	**8.** For further information on quality lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.

requirements	criteria	commentary
9. Controlled environment for proper operation.	**9.** Maintain 70°F ($\pm 2^{\circ}$) and 50 percent relative humidity (± 5 percent continuously. Provide 5 cubic feet per minute per person outside air ventilation rate or the outside air quantity necessary to maintain a room pressurization requirement of .05 to .10 water gage.	**9.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
10. Electrical power.	**10.** Provide 120/128 electrical service and 120-volt outlets--one receptacle for every 10 linear feet of wall. Outlets for equipment should be available under the raised floor as per layout. Electrical power must fall within the 10,000 to 500,000 watt range, with frequency levels at 50 to 60 hertz ± 5 percent.	**10.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**11.** Vaulted enclosure walls--2 hour (minimum) fire-rated, shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area--Automatic fire detection: Local alarm. Automatic Halon 1301 suppression system if required for cross-zoned or matrix detection. Sprinkler and Halon systems are not normally installed in the same areas.	**11.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Equipment expansion

It is advisable to arrange equipment in the equipment room such that future expansion of the building will not necessitate complete rearrangement. (2) 5-21

Approximately 3 feet of clearance space, as a minimum, should be allowed in front of and to the rear of an equipment bay. If a bay does not permit rear access to equipment, the bay can be installed with no clearance on the back side, that is, against a wall or back-to-back with other bays, unless ventilation requirements are compromised. (2) 5-21

5. Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on raised floors for maximal use of coupled air directly through the cabinets. Cooling air at 60°F supplied directly into the base of the transmitters will leave the top at approximately 72°F. Thus, when the air exits the equipment, it is at a more comfortable temperature for persons working in the space.

8. Control area

Light fixtures should provide an approximate uniform lighting intensity of 70 footcandles and should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. Lights over the area in which the control console is located shall be provided with wide-range (100:1) dimming control. (23)12

Equipment area

Fixtures should be arranged above the operating aisles and should run parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so light is not obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23)12 Portable task lighting should also be supplied for the equipment area at 70 to 100 footcandles.

9. Protection from moisture migration

Operating spaces that contain electronic equipment usually require close temperature and humidity control. Vapor barriers placed under floor slabs and roofing usually prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided if exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

best copy available

guidance

Mechanical

The recommended operating temperatures and humidity conditions should be obtained from the manufacturers of the communications and data processing equipment and should be used in designing the environmental control system.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Inadequate cooling contributes as much to failure as poorly regulated power. (74) 4-17

Even though certain individual units can operate outside the limits of the overall specifications, overall environmental requirements are dictated by the most restrictive unit of the system. The computer system's requirements are the major considerations; however, good design will also consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in the following ways. (74) 4-17

- Heat dissipation by computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The number of air changes per hour varies between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Also, if the air-conditioning requirements are not met, a record must be available to indicate the extent and duration of the undesirable condition and indicate whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-25

guidance

- Insure the air-conditioning system continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is needed when humidity limitations are exceeded. Drying out may be necessary if the excess humidity occurs either during periods of actual operation or while the machine is shut down and unattended. The extent and duration of excessive humidity determines the length of the drying-out period.
- Determine if the environment meets requirements for the machine.

A visual or audible signaling device is desirable in the recording instrument. This is to provide visual or audible indication that temperature or humidity in the computer area is nearing the maximum limit.

Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The recorder is usually located at a representative spot in the room and adjacent to the control devices.

For monitoring underfloor air conditions, a remote indicating instrument is recommended. This is usually a 7-day electric-drive chart and can be the wet-and-dry-bulb or electronic type if direct reading is not available. The recording instrument can be located on the wall in the operations room, in the mechanical equipment room, or in any other location convenient to the building engineer.

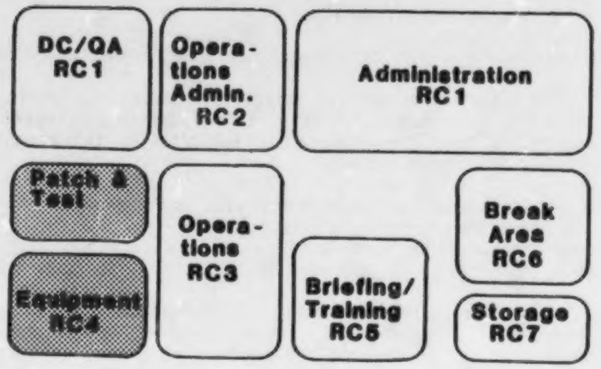
10. Electrical

Consider providing a flexible system that will meet the facility's future requirements. Electronic equipment is constantly being upgraded, modified, and replaced. Bus duct systems and cable trays may prove to be most flexible for areas in which new equipment is expected or that may have frequent modification. (5) 3-4-8

Specifically refer to the "Electrical" portion of "Issues and Assumptions" portion of SB2, Vol. 2, for information relative to host nation power requirements. Additional information may be found in "guidance" of SB2 with respect to the standard frequencies and voltage levels used by various nations.

Provide host nation standard outlets if applicable.

EQUIPMENT ROOM RC4


DC/QA RC1
Opera-tions Admin. RC2
Administration RC1
Patch & Test
Opera-tions RC3
Break Area RC6
Equipment RC4
Briefing/ Training RC5
Storage RC7

function

To house the mainframes, CRYPTO, and patch-and-test equipment that interconnect the RCOC with communication customers.

policy/sop

1. Routine RCOC equipment maintenance is usually done by military personnel or contractors assigned to nearby communication stations. The RCOC equipment room requires a workbench, tool rack, and parts storage cabinets.

issues and assumptions

1. Automated recordkeeping

CRTs with hardline printers can streamline paperwork by storing all circuit history files on disk, thus eliminating time-consuming paperwork. This will allow rapid in-house troubleshooting.

activities

1. Conducting patch and test work.
2. Isolating faults.
3. Typing reports.
4. Training personnel.

personnel

1. Shift personnel as required.

equipment *

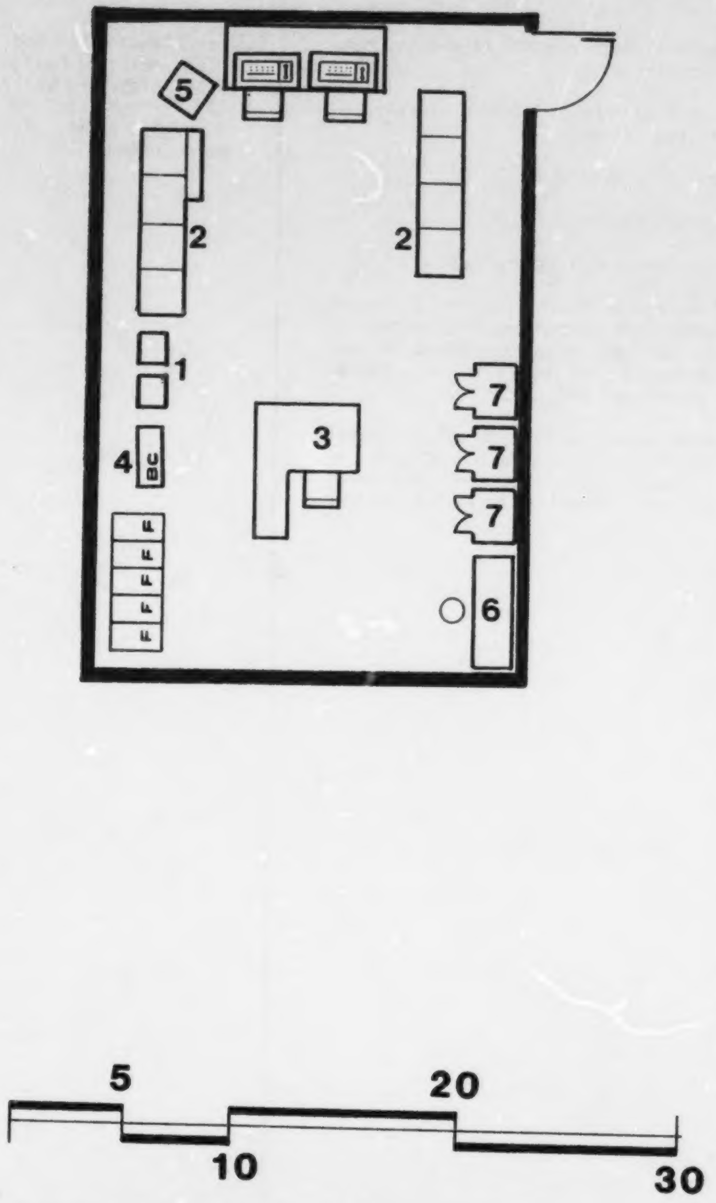
1. Quality assurance test equipment.
2. Patch and test bays.
3. Desk with chair.
4. Book shelving for manuals (20 linear feet).
5. Filesafe for classified information, five drawers.
6. Maintenance workbench (30 by 96 inches) with tool rack and display panel.
7. Three lockable storage cabinets (24 by 36 inches).

* See "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space for transmission equipment layout.	**1.** Space needs vary due to extent of testing and maintenance equipment. Typical layout is for 600 square feet.	
2. Enough space to accommodate the inspection and testing of communication equipment and for storage.	**2.** Provide a 48-inch workspace behind all equipment. This space must allow inspection, testing, and repair.	
3. RFI shielding.	**3.** Shielding is required for electrical and electronic equipment to prevent the propagation of interference and to protect against interference propagated by other electronic devices. (15a)7	**3.** See also Vol 2, SB4, Grounding, Bonding, and Shielding along with SB5, EMP/HEMP Protection.
4. Raised floor system.	**4.** Raised or false floors are necessary for proper cooling of the equipment.	**4.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
5. Interior finishes suitable for durability, maintenance, and room function.	**5.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor with a dust-on finish with hardener. See Vol 2, SB2--Interior Construction. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	**5.** See also Vol 2, SB2, Interior Construction and Finishes.
6. Acoustical isolation/attenuation for variable noise levels produced by electrical equipment.	**6.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile is also required to within 4 feet of the floor.	
7. Adequate lighting.	**7.** Ambient lighting should be 20 footcandles. For testing and inspection, use 70- to 100-footcandle task lighting.	
8. Proper environmental control for electronic equipment.	**8.** The environment temperature should be at 73°F (±2°) and 50 percent relative humidity (± 5 percent). Transmission area should have filtered air. (See MIL-HDBK 411A.)	**8.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
9. Electrical power.	**9.** Provide 120/208 electrical service. Electric power may fall within the 10,000- to 50,000-watt range. Voltages are required at 50/60 hertz ± 5 percent. Provide one 120-volt outlet for every 10 linear feet of wall and as required for coordination with equipment.	**9.** See also Vol 2, SB 2, Communication Station Buildings--Electrical.

requirements	criteria	commentary
10. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**10.** Vaulted enclosure walls--2-hour minimum fire-rated construction; shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area automatic fire detection--Local alarm; automatic Halon 1301 suppression system if cross-zoned or matrix detection is required. Sprinkler and Halon systems are not normally installed in the same areas.	**10.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

4. Raised floor systems

Most equipment that requires significant cooling to maintain communication operations should be located on a raised floor system so that maximum flow of cooled air directly through the cabinets is possible. Cooling air (60°F) supplied directly into the base of the transmitters will leave the top at approximately 72°F. When the air exits the equipment, it is at a more comfortable temperature for personnel working in the space.

7. Equipment area

Fixtures should be arranged above the operating aisles, running parallel to equipment row arrangements. They should be located so as not to cast shadows or reflections on the front of the technical equipment or to be obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RF interference filters (GE no. 89G635, Sprague IF-37, or equivalent). Lights shall not interfere with access to the cable trays or equipment. (23)12 Portable task lighting should also be supplied for the equipment area at 70-to 100 footcandles.

8. Protection from moisture migration

Operating spaces that contain electronic equipment usually require close control of temperature and humidity. Vapor barriers placed under floor slabs and incorporated into roofing usually prevent moisture migration into and out of interior electronic equipment spaces. However, additional protection must be provided when exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

Air-conditioning

Continuous, reliable operation of computer systems depends on an efficient, well designed, properly controlled air-conditioning system. Lack of adequate cooling contributes as much to failure as poorly regulated power. (74) 4-17

Even though certain individual units can operate outside the limits of the overall specifications, the system's environmental requirements are dictated by its most restrictive unit. Computer system requirements are the major considerations in air-conditioning system design. However, good design will also consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in the following ways: (74) 4-17

- Heat dissipation by the computers is relatively constant; therefore, year-round cooling is required.

- The computer room sensible heat ratio is near unity because all heat dissipated by the computer system is sensible.

guidance

- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The number of air changes per hour varies between 30 and 60 because of the computer equipment's high heat dissipation.
- Year-round humidity control is required to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended in electronic equipment areas because this can cause damage. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are required to provide a continuous record of temperature and humidity in the machine area. Also, if the air-conditioning requirements are not met, a record is available to indicate the extent and duration of the undesirable condition and to show whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-25

- Insure that the air-conditioning installation continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a drying-out period is necessary when humidity limitations are exceeded. Drying-out may be needed if the excess humidity occurs either during actual system operation or when the machine is shut down and unattended. The extent and duration of the excess humidity is used to determine the length of the drying-out period.
- Determine if the environment in the area meets the requirements for the machine.

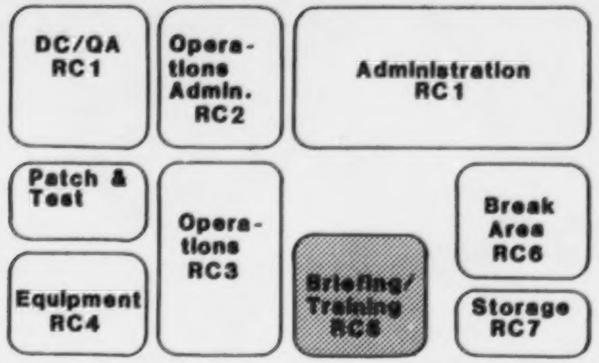
A visual or audible signal in the instrument is desirable to indicate when temperature or humidity in the computer area is nearing maximum limit.

Direct-reading instruments with a 7-day electric-drive chart are sometimes used to monitor ambient room conditions in installations. The recorder is usually located at a representative point in the room and adjacent to the control devices.

A remote indicating instrument is recommended for monitoring the underfloor air. This is usually a 7-day electric-drive chart and can be the wet-and-dry bulb or electronic type if direct reading is not available. This instrument can be located on the wall in the room, in the mechanical equipment room, or at any other location convenient to the building engineer.

guidance

BRIEFING /TRAINING RC5



function

To hold briefings with center and customer communication personnel. To improve personnel capability and effectiveness, both technically and personally. To develop and implement station master training program.

policy/sop

1. Technical training proceeds at two levels: (a) hands-on experience, i.e., working directly with the communications equipment, and (b) learning from manuals, publications, and audiovisual equipment. Physical training also proceeds at two levels: (a) indoor individual exercise and (b) outdoor small group recreational activities, especially at remote DCS facilities that are not on military installations.

2. Current policy requires that personnel be allowed time for technical training while on duty at the facility.

3. Training usually is conducted while the communication activity is at its lowest level.

4. Some communication personnel may be engaged in a CDC (Career Development Course); a training area is required for this purpose. (The Air Force counterpart is the QTP [Quick Training Package].)

5. Training usually is conducted by the shift supervisor or a lead NCO/CO who also is on duty.

6. For fire/life safety training, "safety" implies the absence and/or control of conditions that can cause personal injury or death or damage to or loss of equipment or property. Within the system, safety is concerned with eliminating or controlling factors affecting the safe, efficient operation of personnel, equipment, and facilities organized to attain a common goal.

   The objective of safety "training" is to insure maximum freedom from inadvertent, possibly destructive mishaps resulting from facilities, equipment, procedural, or personnel deficiencies during all phases of system operation. (70) 15-30

issues and assumptions

1. Three-shift versus four-shift impact on training time available.

Most facilities operate on a three-shift basis:

Day shift:	8 a.m.	4 p.m.
Swing shift:	4 p.m.	Midnight
Midshift:	Midnight	8 a.m.

By having personnel assigned to four shifts instead of three, one group could be a "training shift" that would be on duty during the day time; thus, the peak activity period would have twice as many personnel available if required. In addition, trainees would have the best opportunity to interact with facility functions.

However, the four-shift concept assumes one or both of the following:

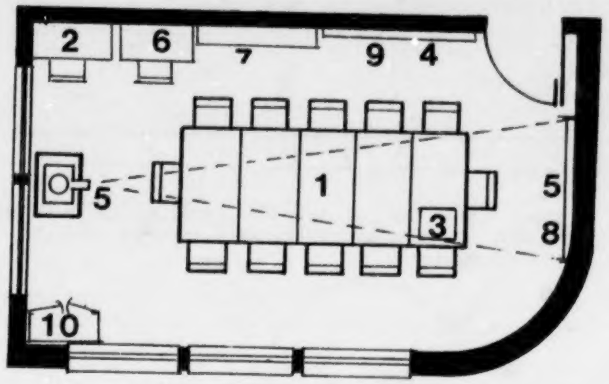
a. More people will be assigned to the site.
b. Staffing of the three operating shifts can be reduced.

activities	personnel	equipment *
Briefing 1. Briefing personnel on communication system status. Technical training 1. Observing evaluation personnel records and conducting personnel interviews to determine training requirements. 2. Developing overall master training plan and presenting special MOS training module program for a specific focus. 3. Reading and studying publications. 4. Watching video cassettes, 16 millimeter movies, and slides. 5. Conducting fire/life/mission safety instruction.	1. Briefing groups. Instructors 1. Commander. 2. Noncommissioned officer in charge. 3. Civilian technicians (not an office area for personnel).	Classroom/conference **1.** Table and seating for twelve. **2.** Television monitor/CRT terminal. **3.** Viewgraph projection system. **4.** Charts and display panels. **5.** Audiovisual projector(s) and screens **6.** TEC library monitors. **7.** Library of written instruction materials (20 linear feet of shelving). **8.** Chalkboard. **9.** Tackboard for training and information bulletins. **10.** Audiovisual equipment storage cabinet. **11.** Intercom speaker.
Physical training Training for mandatory military requirements in: • physical fitnesss • weapons qualifications • chemical-biological-radiological warfare.		Fitness area **1.** Exercise equipment: 8 by 4 foot mat, weight set, exercycle. **2.** Exterior area for volleyball and half-court basketball. **3.** Athletic and recreational items, e.g., balls, bats, and horseshoes. **4.** Intercom speaker.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
Technical training		
1. Enough space for small groups (up to 20 people) that meet for small training seminars. Space for reading and studying manuals and other publications associated with the training function.	**1.** Provide 25 square feet of space per person. Equipment layout and storage require additional square footage.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Vinyl asbestos tile. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation from the high noise level generated in the operations area.	**3.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**3.** See reference 201, page 3-4, Table 3-2.
4. Flexible lighting.	**4.** Provide adjustable lighting, depending on varied uses. • 20 to 80 footcandles at each work surface. • 10 footcandles at rear of room during audiovisual projection. Surface reflectances should be: • Ceiling: 80 to 90 percent • Walls: 40 to 60 percent • Floor: 20 to 40 percent.	**4.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for occupants.	**5.** Regulate temperature at 68°F (heating), 78°F (cooling) with 5 cubic feet per minute per person outside air ventilation rate. Seating should be adjustable to provide maximal body support comfort for many different sizes.	**5.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
6. Electrical power.	**6.** Provide 120/208 electrical service. Provide 120-volt outlets--one receptacle for every 10 linear feet of wall. Specific equipment outlets depend on the room layout.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



1 1-- speaker in ceiling

guidance

1. Location

Since most technical training involves hands-on experience with the communications equipment, the training room should be adjacent to the operations space and should have a view into the operations space if possible.

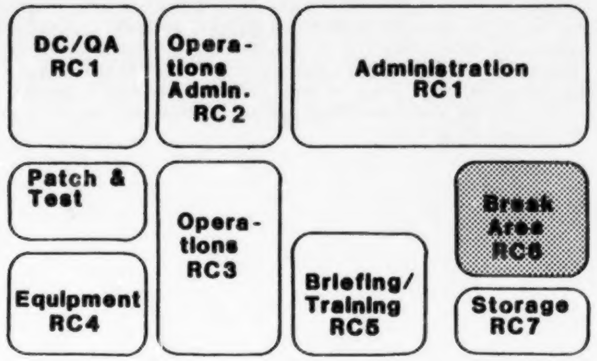
4. Lighting design

Classroom lighting immediately in front of a lecture platform can be controlled from a point convenient to the speaker's platform and also at the entrance. Lighting can be controlled by motor-operated dimmers from the platform and the main entrance to facilitate use of audiovisual aids. Lighting can also be controlled from those points by switches. Minimum lighting shall be provided so that notes can be taken during the use of visual aids.

1. Physical training

See "storage" for interior physical training area guidance drawing.

PERSONNEL SUPPORT/BREAK AREA RC6


DC/QA RC1
Operations Admin. RC2
Administration RC1
Patch & Test
Operations RC3
Break Area RC6
Equipment RC4
Briefing/Training RC5
Storage RC7

function

To create a change of environment for on-duty personnel as a break from the hard surface equipment room and work areas.

policy/sop

1. The intense activities in the DCS facility generate personnel fatigue making it necessary to provide an area separate from the communication function.
2. Current policy requires personnel to have a 15-minute break every 3 to 4 hours. Typical schedules also allow 30-minute meal breaks.
3. Most communication personnel "brown bag" their meals since they cannot leave the facility during a shift. Therefore, basic food preparation equipment is required: a kitchenette-sink, hot plate, refrigerator, cabinets, and range.

issues and assumptions

activities

1. Relaxing.
2. Reading.
3. Eating.
4. Storing food.
5. Preparing food.
6. Storing personal items such as coats and books.

personnel

1. Two to eight at once.

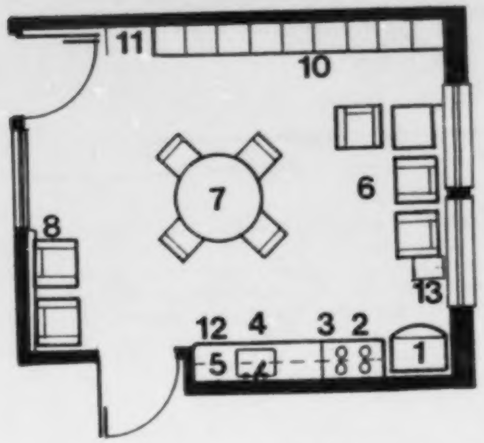
equipment*

1. Refrigerator.
2. Stove.
3. Range and range hood.
4. 20 x 30 inch sink in countertop which is a 6-foot minimum with cabinets above.
5. Coffee machine.
6. Chairs.
7. Table with chairs for eight.
8. Bulletin boards.
9. Intercom speaker.
10. Storage lockers for each person. (Not required for personnel who have private offices.)
11. Coat rack.
12. Microwave oven (if communication equipment is not affected).
13. Trash receptacles.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the personnel support/break area.	**1.** Provide approximately 300 square feet of space for equipment and furniture to accommodate up to 10 personnel.	
2. Visual separation from the communications equipment.	**2.** Provide visual separation that also allows viewing of the operations area when desired. Supply comfortable furniture and carpeting (earth tones are recommended).	
3. Interior finishes suitable for durability, maintenance, and room function.	**3.** Floor--Vinyl asbestos tile and area carpeting. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**3.** See also Vol 2, SB2, Interior Construction and Finishes.
4. Acoustical isolation and attenuation for a nondisruptive environment.	**4.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	
5. Lighting suitable for reading (task and ambient).	**5.** Use 20 to 30 footcandles for ambient lighting and 100 footcandles for task lighting.	
6. Thermal comfort.	**6.** Control temperature for 68°F (heating) and 78°F (cooling) with a 5-cubic feet per minute per person outside air ventilation rate.	**6.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
7. Electrical power.	**7.** Provide 120/208 electrical service. 120-volt outlets should be installed for every 10 linear feet of wall. Counter height outlets are required for a coffee maker, mixer, microwave oven (when permitted), and other appliances.	**7.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
8. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**8.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**8.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety for more information.

guidance



9-- speaker in ceiling

guidance

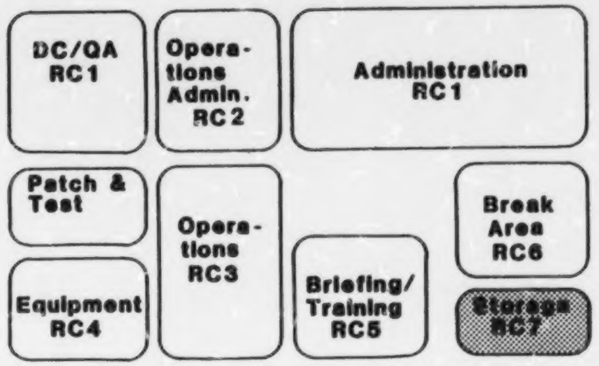
1. Location

The personnel space should be directly adjacent to the operations room, but isolated acoustically (absorptive walls) and visually (a curtain hung at the window).

3. Visual comfort

The color contrast, textures, and designs of the wall, ceiling, and floor surfaces should minimize glare for a comfortable environment.

STORAGE RC7


DC/QA
RC1
Opera-
tions
Admin.
RC2
Administration
RC1
Patch &
Test
Opera-
tions
RC3
Break
Area
RC6
Equipment
RC4
Briefing/
Training
RC5
Storage
RC7

function

To provide for temporary placement of miscellaneous items and nontechnical equipment.

policy/sop

1. All services have physical fitness requirements that must be met annually. For remote DCS facilities without installation services, it is recommended that exercise equipment be made available. The exacting, sometimes intense, activities of maintaining and controlling the DCS require periodic breaks for physical exercises.

issues and assumptions

1. Storage for exercise equipment

The exercise equipment should not conflict with the function of other personnel-oriented rooms. A general purpose storage room is suitable since the equipment is unofficial.

activities

1. Shelving of miscellaneous sized items.
2. Individual exercise.

personnel

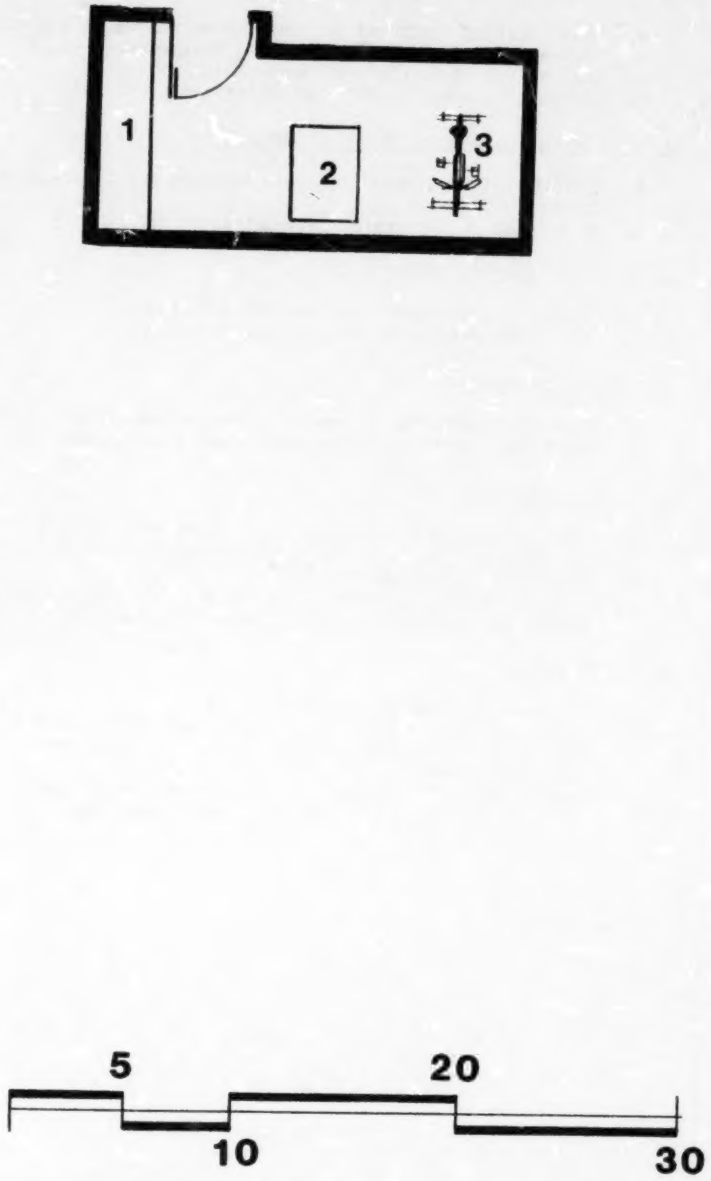
equipment *

1. Shelving 18 inches deep.
2. Small step ladder.
3. Exercycle, universal gym, and/or loose weights.

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate two or three persons exercising, plus space to move about for shelving items.	**1.** Allow approximately 200 square feet to accommodate the exercise equipment plus 60 linear feet of shelf space.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Concrete, hardened and sealed. Base--Not applicable. Walls--Paint. Ceiling--Exposed and painted.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	**3.** Adjacent room walls should limit sound transmission to 40 decibels.	
4. Adequate lighting.	**4.** Use 30-footcandle (ambient) fluorescent fixtures.	
5. Thermal comfort.	**5.** Regulate temperature at 68°F (heating), 78°F (cooling). Provide 10 cubic feet per minute per person outside air ventilation rate with on-off switching.	**5.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
6. Electrical power.	**6.** Install 120/208 electrical service. Provide 120-volt outlets--one receptacle for every 10 linear feet of wall. Frequency levels should be at 50 to 60 hertz ± 5 percent.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance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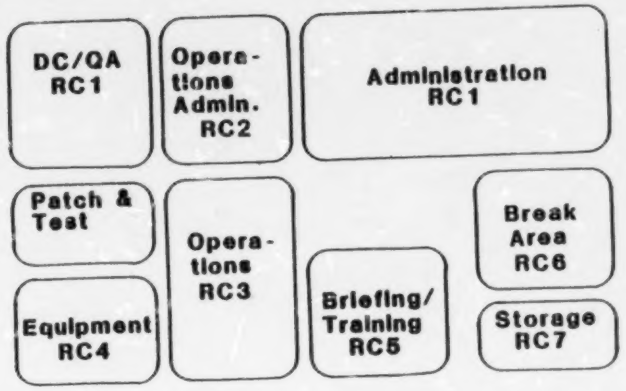
guidance

STANDARDIZED MODULES RC8



building design principles

1. Efficiency of operational functions

a. Communication equipment aligned for surveillance and access.
b. On-the-job training with operating equipment.
c. Interaction of operational support activities.
d. Accessibility of toilets for operations personnel.

2. Efficiency and accessibility of administration spaces

a. Administration transition space between public areas and secure spaces.
b. Efficiency of integrated administrative spaces.

3. Personnel support spaces

a. Change of environment for on-duty personnel.
b. Facilities available for physical training.

4. Facility expansion

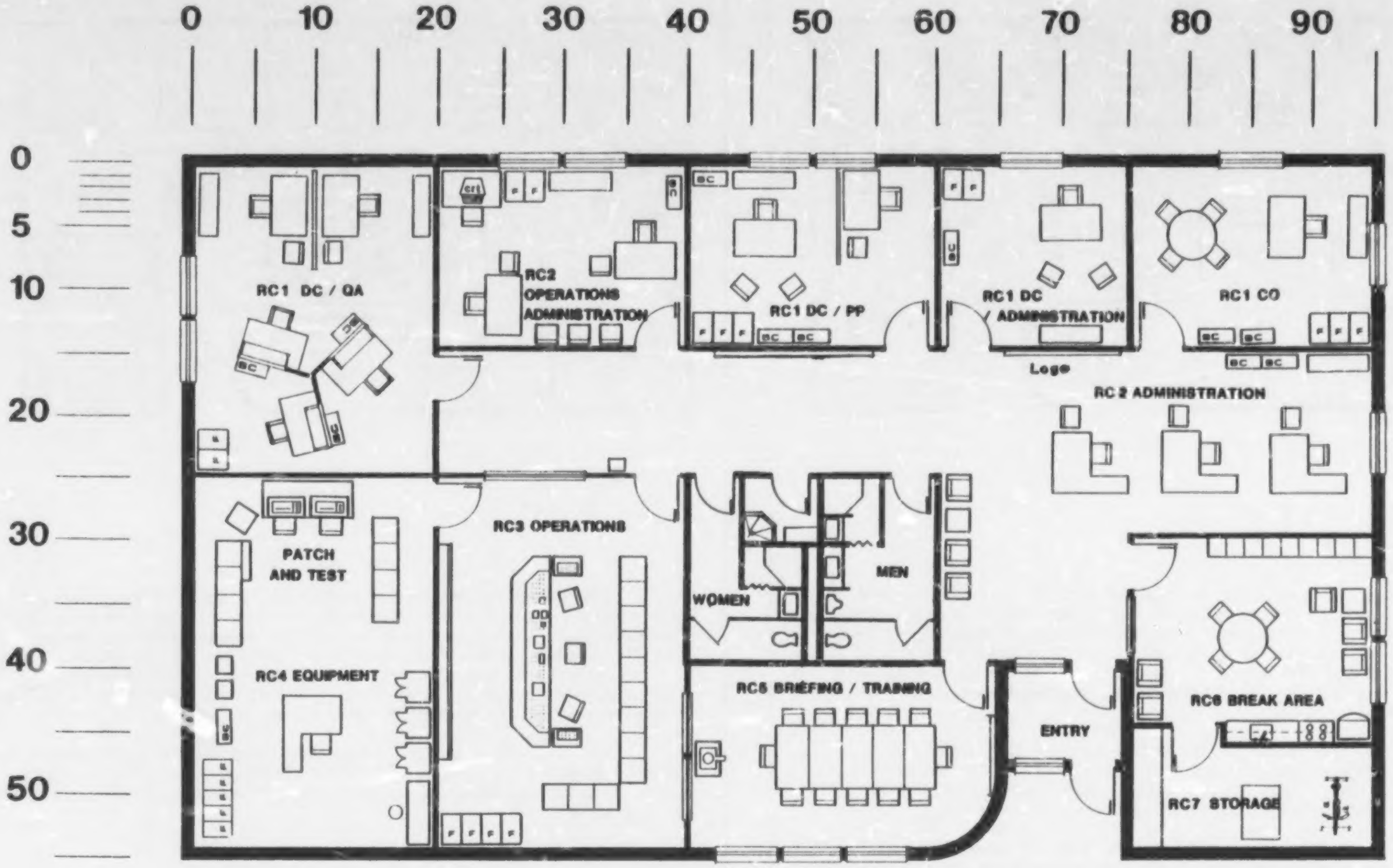
a. Expansion potential in new construction operations space.
b. Minimized impact of future operations space expansion.

5. Fire protection

a. Fire protection classifications: occupancy, hazard of contents, sprinkler protection, and construction/materials.
b. Building separation distances.
c. Fire protection systems: automatic fire suppression, automatic notification/alarm, and automatic fire detection.

6. Life safety

a. Occupant load determination.
b. Protected exit conditions: exit capacities, number of exits, exit travel distances, and means of exit arrangement.
c. Allowable interior finishes.
d. Egress path identification: illumination of means of egress, emergency lighting, and means of egress marking.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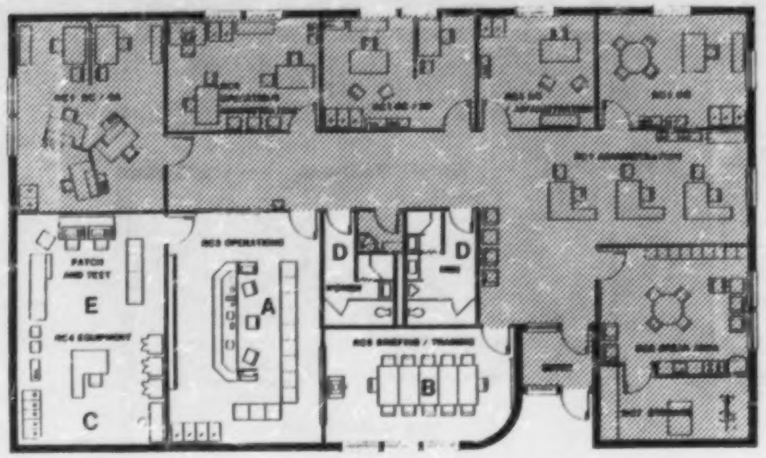
RC1 DC / QA
RC2 OPERATIONS ADMINISTRATION
RC1 DC / PP
RC1 DC / ADMINISTRATION
RC1 CO
Logo
RC 2 ADMINISTRATION
PATCH AND TEST
RC3 OPERATIONS
WOMEN
MEN
RC4 EQUIPMENT
RC5 BRIEFING / TRAINING
ENTRY
RC6 BREAK AREA
RC7 STORAGE

guidance 1. Efficiency of Operational Functions



A Equipment should be aligned in parallel rows within the operations modules for ease in visual surveillance and to provide direct access to all critical equipment. Multiple consoles should be adjacent to each other so that limited personnel can monitor them efficiently at one central location. Tables for audiovisual training aids should be available in operations modules so that personnel can train on-the-job during regular watch periods.

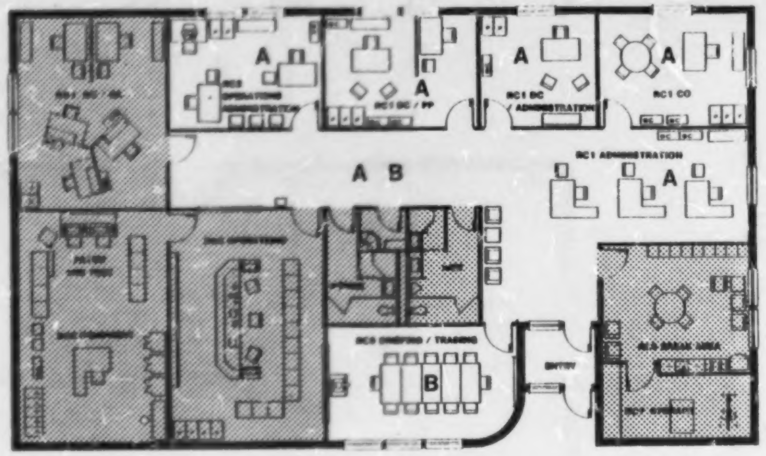
B To further enhance the effectiveness of on-the-job training, instruction can be done in small groups of four or five in a training room for hands-on experience with communications equipment. This requires a close relationship with the operations module.

C Additional building modules with a close functional relationship to operations activities should be located adjacent to the operations module.

D Toilet facilities should be nearby for personnel in the operations module.

E See patch and test information in section PT of this volume.

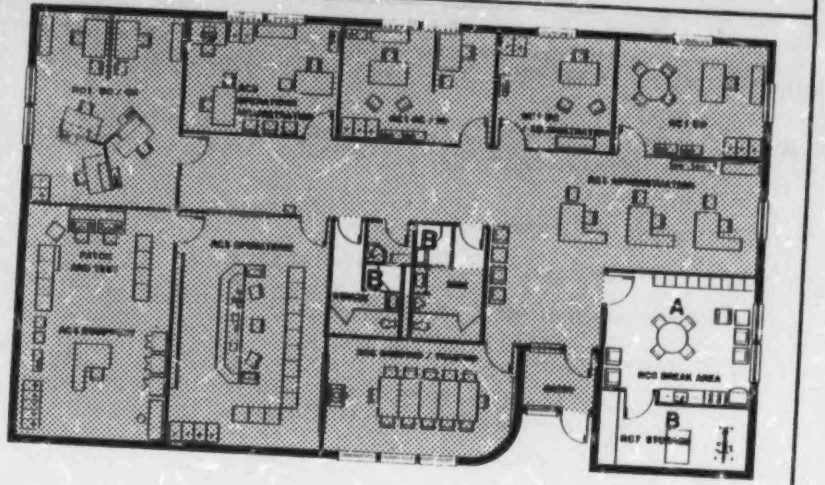
guidance 2. Efficiency and Accessibility of Admin. Spaces



A Administration modules must be easily accessible to the public to minimize circulation and to prevent visitor interference with facility operations. The administration modules should provide a buffer and transition space between the exterior and interior secure spaces. Also, public corridors in the administration area should contain military unit logos and other display panels that relate to the "esprit de corps" and unit integrity of the communication station.

B Administration spaces' integrated relationship will improve efficiency by minimizing public and administrative circulation and by producing a group adjacency to shared conference areas, secretaries, and waiting areas.

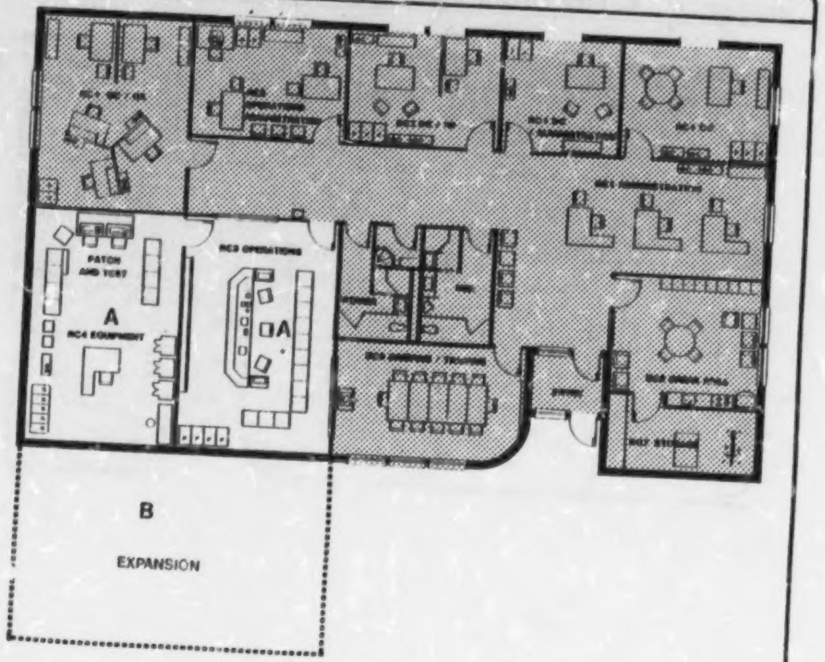
guidance 3. Personnel Support Spaces



A The intense activities inside the DCS facility tend to generate mental fatigue among personnel. It is therefore necessary to create a change of environment for on-duty personnel to provide a break from the "hard surface" equipment room and work areas. The personnel support module should be directly adjacent to the operations room, but isolated acoustically and visually.

B In addition, physical exercise equipment is recommended for DCS facilities located off military bases. The necessary showers and lockers should be similarly adjacent to the operations module for easy access and optimal use.

guidance 4. Facility Expansion

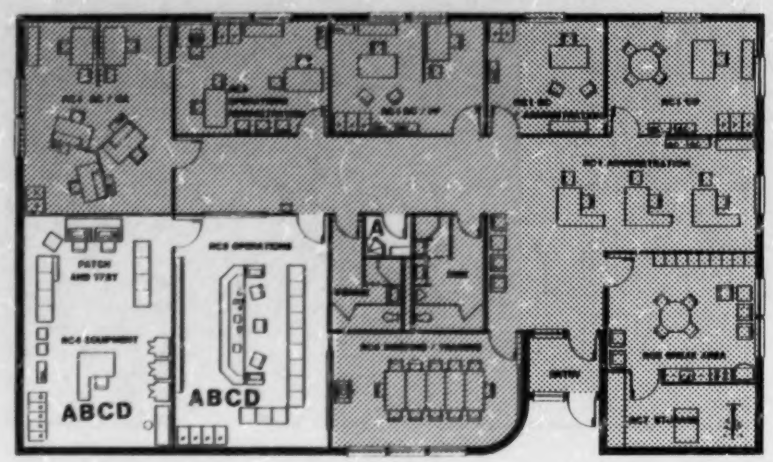


A The equipment layout should be planned in a way that affords enough space for the installation of equipment capable of handling the maximum projected traffic load. The initial equipment layout should be such that the station facility's ultimate expansion can be done without extensive rearrangement of existing equipment.

B Operations modules should be functionally isolated from support and power modules. Because of the increasingly rapid changes in communications technology, new demands on the spatial layout of operations modules can be expected in the future. Such spaces must be able to expand to accommodate new equipment and new functions. It is not anticipated that support and power spaces will need this same expansion capability and, therefore, may be located in their own areas; that is, facility design should allow operations modules to expand without greatly affecting the remaining functions.

C A facility must be able to respond to major changes in mission or functional requirements such as the addition of other modules (for example, a "Technical Control" or a "Patch and Test"). Thus, the facility must be able to adapt to mission expansion.

guidance 5. Fire Protection



Occupancy classifications: Business (NFPA); B-2 (UBC)

Hazard of contents classification: Ordinary hazard

Sprinkler protection classification: Ordinary hazard--group 2.

Construction classifications/materials for fire protection (See Vol 2, the first figure in SB3, Fire Protection/Life Safety)

A Type II--One-Hour (UBC) for battery, cryptography (RED/BLACK),* custodian, generator, operations,* mechanical, and transmission spaces:

All construction elements.......1-hour rated construction

Type II--N (UBC) for remainder of building spaces

All construction elements.......Noncombustible construction

Building Separation

Site-specific information is required. Comply with the second figure in Vol 2, SB3, Fire Protection/Life Safety.

Interior finishes

See Guidance/Life Safety, Vol 2.

Fire protection systems

Automatic fire suppression

A water sprinkler system shall be provided throughout the entire facility.

B A Halon 1301 or carbon dioxide system shall be provided under raised floor areas containing nonmetallic, sheathed, exposed cables when the space under the raised floor is used as an air plenum.

Automatic notification/alarm

A general alarm must be activated by the automatic sprinkler system.

C Local alarms are required to sound only in the designated spaces; they are activated by smoke detectors.

Automatic fire detection

D Smoke detectors are required to activate local alarms only in the designated spaces. In rooms containing raised floor areas, smoke detectors shall be located under the raised floor.

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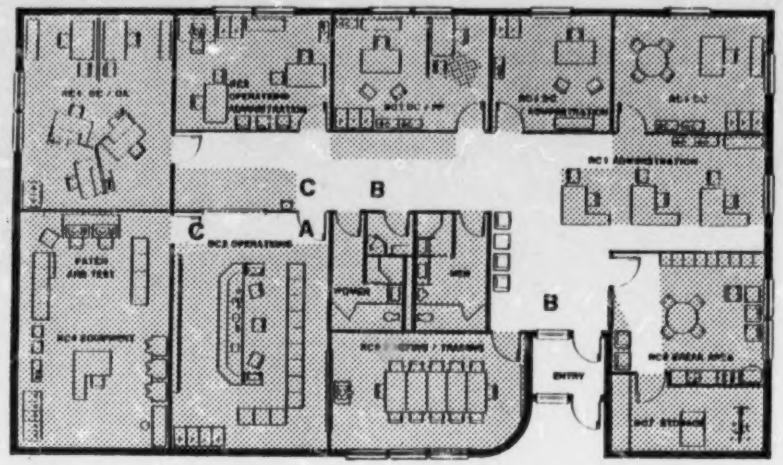
*See Vol 2, SB7, Security, for vault construction requirements that may be more stringent than those imposed by fire protection requirements.

guidance 6. Life Safety



OCCUPANT LOAD FOR DETERMINEING EXIT REQUIREMENTS.

Occupant load factor: 100 square feet per person based on gross floor area (Business Occupancy-NFPA)

Occupant load (total facility) $= \frac{5140 \text{ sq ft}}{100}$ = 51 persons

Occupant load (vaulted area) $= \frac{1200 \text{ sq ft}}{100}$ = 12 persons

Occupant load (admin/support) $= \frac{2800 \text{ sq ft}}{100}$ = 28 persons

Exit capacities

Corridors--100 persons per unit of exit width for travel in either direction. The minimum width of any exit access corridor or passageway shall be 44 inches in the clear.

Doors--100 persons per unit of exit width (a 3-foot door provides 1.5 units of exit width, providing an exit capacity for 150 persons).

Number of exits

No less than two exits shall be accessible from every part of every floor. One exit is permitted when the room or area has: (1) a total occupant load of less than 100 persons, (2) direct exit to an open area outside the building at the ground level, and (3) a total travel distance on the same level of not over 100 feet. (If stairs are involved, they shall be no more than 15 feet in height and shall be provided with complete enclosures to separate the stairs from any other part of the building.)

Exit travel distances

Required exits shall be located to allow access without passage through areas that may be locked. No dead end corridor shall exceed 50 feet. Travel distance to exits shall be no more than 300 feet when the building is protected throughout by an approved automatic sprinkler system.

Arrangement of means of egress

Exit access and travel routes to exits are shown in the plan.

A Exit doors in vaulted areas that contain communications equipment are secured and permit egress out only. Exit access routes through vaulted areas from spaces outside the vaulted area are not permitted for security reasons.

Interior finishes

B Interior finish in exit access corridors shall be Class A only.

Interior finish in the remainder of the building shall be Class A or B only.

guidance

Means of egress lighting

Exits and exit access, including stairs, aisles, corridors, and passageways leading to an exit, shall be lighted continuously during times when the conditions of occupancy require means of egress to be available. Lighting should be no less than 1 footcandle measured at the floor.

Emergency lighting

Emergency lighting shall be provided in windowless buildings for designated aisles, corridors, and passageways leading to an exit. Emergency lighting shall stay at least 1 footcandle throughout the means of egress for 1.5 hours in the event of normal lighting failure.

Marking the means of egress

Exits shall be marked by an approved sign readily visible from any direction of exit access. Signs shall be placed such that no point in the exit access is more than 100 feet from the nearest visible sign.

C Doors located or arranged so that they are likely to be mistaken for exits shall be identified by a sign reading "NOT AN EXIT."

guidance

Technical Control [TC]

MOST current DCS transmission and switching systems are based on analog technology. During 1980 to 1990, DCS analog transmission facilities will be replaced with state-of-the-art digital technology. Electromechanical switches, which now support common-user voice traffic, will be replaced by digital switches procured under programs such as the Air Force Scope Dial and the Army European Telephone System (ETS). Aging Voice Frequency Carrier Telegraph (VFCT) multiplexers, which provide teletype circuits, will be replaced by the Low-Speed Time Division Multiplexer (LSTDM). The LSTDM will be able to provide a transmission path for various types of data and other digital circuits from less than 35 bytes per second up to 64 kilobytes per second. Furthermore, to accommodate changes in digital data requirements and to capitalize on DCS evolution toward digital operation, a Data Transmission Network (DTN) is being planned to achieve more efficient, effective data transmission. The DTN generally will be phased with the development of digital transmission facilities throughout the DCS and will be structured to accommodate new digital signals as well as those now satisfied by voice frequency (VF) modems and the VFCT network. The increasing sophistication and expansion of various communications networks and equipment within the DCS create a need to improve transmission circuit and technical control functions to supervise and manage the DCS effectively.

DCA Technical Note 6-82 (reference 151), Time-Phased Deployment of the Digital Patch and Access System (DPAS) in the DCS Europe, contains information on how TC rooms using digital equipment affect the facility.

Technical Control (TC) TC-1
TC1 TC Operations TC-2
TC2 TC Administration TC-10
TC3 Standardized Modules TC-14

OPERATIONS TC1

TC Administration
TC2

TC Operations
TC1

function

To provide for the interface function between the communication system's various transmission elements.

policy/sop

1. Technical control (TC) includes the necessary physical, electrical, and manpower capabilities that provide (a) technical direction, (b) coordination, (c) technical supervision of transmission media and equipment, (d) quality control, (e) communications service restoral, and (f) status reporting for the various elements of the communications system.

issues and assumptions

1. No persons authorized for security activities

   Since no personnel are specifically assigned, these activities pull personnel away from the facility main mission--reliable communication.

2. Higher security required for newer equipment

   A problem with current communication system expansion as new technology increases is the need for greater security within the space available.

3. Extent and location of d.c. and audio patch panels

   The amount of d.c. patch required is based on the number and distribution of the d.c. channels coming into and leaving the communication facility. Current levels of channels range from one bay up to 15 or more at a major technical control facility, such as a Navy Fleet Center. The equipment layout must accommodate the controllers need to be at the teletype orderwires and look at the monitoring meters on the d.c. and audio patch panels.

4. Extent of teletype orderwire contact versus voice orderwire contact with communication customers

   HF radio transmission facilities will use teletype orderwire contact with customers rather than voice orderwires, since teletype signals can serve the more limited frequencies available. Thus, technical control equipment layouts with extended teletype racks (15 up to 60) must be located such that patch panel racks are within the controllers' sight while these personnel are at the teletype terminal. The voice orderwire equipment allows the technician to make the voice instrument patch at various locations along the tech control patch panel racks, thus providing greater insurance that required test meters will be in view.

5. Classified versus unclassified cable IDF racks

   For facilities with commercial cable connectors, the facility will require space for one or two IDF racks to allow nonclearance-level personnel to work on equipment and connections. The unclassified racks should be adjacent to the classified rack area, which is part of technical control.

activities

1. Receiving and processing outage reports.
2. Supervising controllers.
3. Isolating faults.
4. Monitoring technical control console.
5. Conducting patch and test work.
6. Typing reports.
7. Training personnel.
8. Reading circuit data cards.
9. Quality control testing.

personnel

1. Shift supervisor.
2. Three to six technical controllers.

equipment *

1. Technical control equipment:
   - o Multiplexers
   - o Modems
   - o Patch panels
   - o Teletypes
   - o Distribution frames.
2. Telephones with call director.
3. Quality assurance test equipment.
4. Shift supervisors' console.
5. Desk with chair for shift supervisor.
6. Table for three shift personnel typing stations.
7. Shelving for manuals.
8. File cabinets for shift supervisor.
9. Filesafes for classified information.
10. Circuit data card "cardex" file.
11. System display.
12. Outage status board.
13. Shredder.
14. Safety board.
15. Intercom speaker.

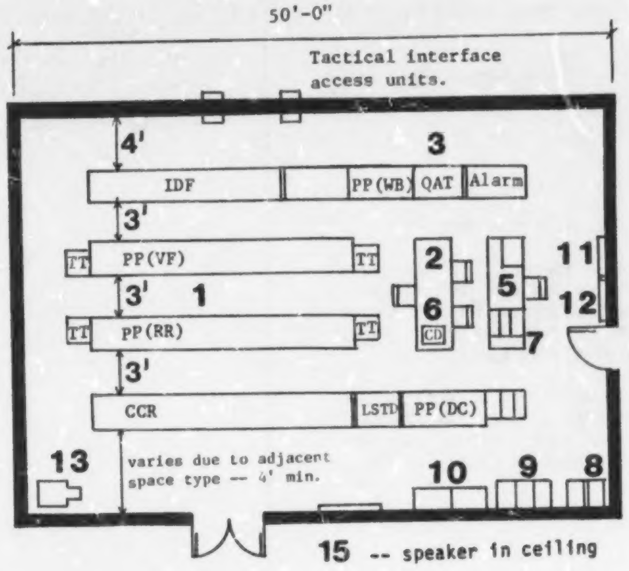
* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Adequate space for the operation and monitoring of communications-electronics (C-E) equipment. Spatial requirements must allow for proper spacing between equipment to facilitate easy maintenance.	**1.** Varies due to extent of communication equipment designed. See layout in Guidance.	
2. A secure environment for C-E equipment.	**2.** The operations room must be lockable when unstaffed and must be supplied with an intrusion alarm system. The operations console should be fitted with alarms for intrusion, power failure, and generator status. Covers should be provided on overhead rods for rapid sanitizing of applicable equipment.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Signal shielding.	**3.** See Vol 2, SB4--Grounding, Bonding and Shielding along with SB7--Security Systems for more information.	
4. EMP/HEMP shielding.	**4.** Shielding is necessary for survivability and uninterrupted functioning when the facility is subjected to EM pulse (EMP) and high-altitude EM pulse (HEMP). Protective measures are based on intercepting the incident energy and dissipating it or reflecting it away from the threatened device, equipment, or facility.	**4.** See Vol 2, SB5, EMP/HEMP Protection, for more information.
5. Raised floor system.	**5.** Raised or false floors are necessary for proper cooling of the equipment.	**5.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
6. Interior finishes suitable for durability, maintenance, and room function.	**6.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor with a dust-on finish that contains a hardener. See Vol 2, SB2--Interior Construction. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Wall--Paint over concrete, gypsum board, or plaster and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	**6.** See also Vol 2, SB2, Interior Construction and Finishes.
7. Acoustical isolation attenuation for variable noise levels produced by electronic equipment.	**7.** Adjacent room walls should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum) and floor surface at NRC .25 (minimum). Acoustic tile is also required to within 4 feet of the floor.	
8. Adequate lighting.	**8.** Lighting shall be specially engineered. Low levels of lighting may be required to permit observation of luminous panels without reflected glare or undesirable contrasts in brightness. Separately controlled luminaires shall be provided for normally lighted operations and for cleaning, with an ambient level of 70 footcandles from fluorescent fixtures.	**8.** For further information on quality lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.

requirements	criteria	commentary
9. Controlled environment for proper operation.	**9.** Maintain 70^{0}F (±2^{0}) and 50 percent relative humidity (± 5 percent continuously. Provide 5 cubic feet per minute per person outside air ventilation rate or the outside air quantity necessary to maintain a room pressurization requirement of .05 to .10 water gage.	**9.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
10. Electrical power.	**10.** Provide 120/128 electrical service and 120-volt outlets--one receptacle for every 10 linear feet of wall. Outlets for equipment should be available under the raised floor as per layout. Electrical power must fall within the 10,000 to 500,000 watt range, with frequency levels at 50 to 60 hertz ± 5 percent.	**10.** See also Vol 2, SB2, Communication Station Buildings--Electrical.
11. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**11.** Vaulted enclosure walls--2 hour (minimum) fire-rated, shielded construction. Interior doors in vaulted walls--1.5-hour fire-rated doors; shielded doors and frames. Interior finish--Class A or B only. Automatic fire detection--Local alarm. Automatic fire suppression--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunciator panel and local fire department or constantly staffed station outside the facility. Manual emergency equipment power shut-off at exits. Under raised floor area--Automatic fire detection: Local alarm. Automatic Halon 1301 suppression system if required for cross-zoned or matrix detection. Sprinkler and Halon systems are not normally installed in the same areas.	**11.** See Standardized Modules--Building Design Principles, and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance

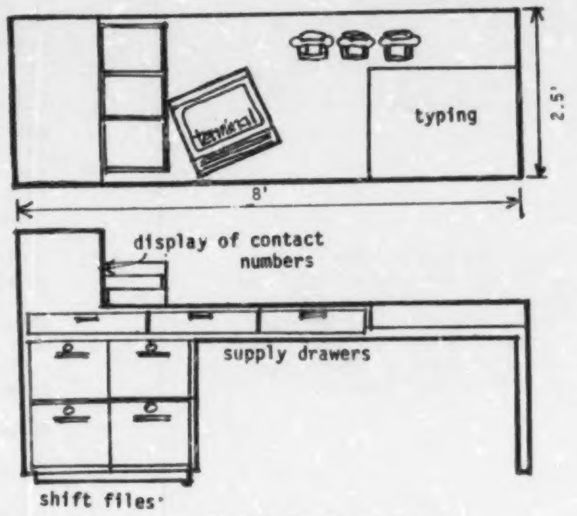
1. All d.c. equipment, i.e., teletype, power supplies, and data hubs, should be located in bays separate from all VF equipment.*
2. QAT units should be located at the first bay slot above the slide-out tray along the entire length of PR and EL patch panels.
3. QAT panels must be wired into the EL and PR patch panels to monitor the circuit test.
4. Large TC facilities should have the alarm panel located at the TC console rather than in the rack area.


50'-0"
Tactical interface
access units.
4'
3
IDF
PP(WB)
QAT
Alarm
3'
TT
PP(VF)
TT
3'
1
2
6
CD
5
11
12
7
TT
PP(RR)
TT
3'
CCR
LSTD
PP(DC)
13
varies due to adjacent
space type -- 4' min.
10
9
8
15 -- speaker in ceiling

*CCR-circuit conditioning racks.
CCF-combined conditioning frames.
PP(VF)-patch panels (voice frequency).
PP(PR)-patch panels (primary).
PP(DC)-patch panels (data center).
PP(WB)-patch panels (wide band).
LSTD-lowspeed time division mux.
IDF-intermediate distribution frame.
QAT-quality assurance test bays.
TT-teletype.
CD-cardex file.

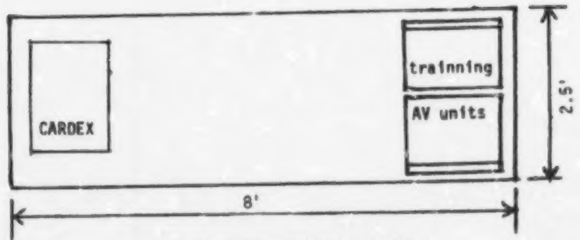
A communications cable vault leading to Tech Control should be considered.

guidance


terminal
typing
2.5'
8'
display of contact
numbers
supply drawers
shift files

Tech Control Console

5. TT orderwire units should be adjacent to the systems they support, whereas TT reporting units should be close to the shift supervisor's console.
6. Remote alarms for Wide Band Secure Voice (WBSV) systems should be located on the alarm rack adjacent to the supervisor's console (when the WBSV equipment is located in a remote transceiver/mux equipment room).


CARDEX
trainning
AV units
2.5'
8'

Trainning/Staff Table

guidance

1. Equipment expansion

It is advisable to arrange equipment in the equipment room such that future expansion of the building will not necessitate complete rearrangement. (2) 5-21

Approximately 3 feet of clearance space, as a minimum, should be allowed in front of and to the rear of an equipment bay. If a bay does not permit rear access to equipment, the bay can be installed with no clearance on the back side, that is, against a wall or back-to-back with other bays, unless ventilation requirements are compromised. (2) 5-21

5. Raised floor system

Most equipment that requires significant cooling to maintain communication operations should be located on raised floors for maximal use of coupled air directly through the cabinets. Cooling air at 60°F supplied directly into the base of the transmitters will leave the top at approximately 72°F. Thus, when the air exits the equipment, it is at a more comfortable temperature for persons working in the space.

8. Control area

Light fixtures should provide an approximate uniform lighting intensity of 70 footcandles and should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. Lights over the area in which the control console is located shall be provided with wide-range (100:1) dimming control. (23)12

Equipment area

Fixtures should be arranged above the operating aisles and should run parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so light is not obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23)12 Portable task lighting should also be supplied for the equipment area at 70 to 100 footcandles.

9. Protection from moisture migration

Operating spaces that contain electronic equipment usually require close temperature and humidity control. Vapor barriers placed under floor slabs and roofing usually prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided if exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

guidance

- Insure the air-conditioning system continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is needed when humidity limitations are exceeded. Drying out may be necessary if the excess humidity occurs either during periods of actual operation or while the machine is shut down and unattended. The extent and duration of excessive humidity determines the length of the drying-out period.
- Determine if the environment meets requirements for the machine.

A visual or audible signaling device is desirable in the recording instrument. This is to provide visual or audible indication that temperature or humidity in the computer area is nearing the maximum limit.

Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The recorder is usually located at a representative spot in the room and adjacent to the control devices.

For monitoring underfloor air conditions, a remote indicating instrument is recommended. This is usually a 7-day electric-drive chart and can be the wet-and-dry-bulb or electronic type if direct reading is not available. The recording instrument can be located on the wall in the operations room, in the mechanical equipment room, or in any other location convenient to the building engineer.

10. Electrical

Consider providing a flexible system that will meet the facility's future requirements. Electronic equipment is constantly being upgraded, modified, and replaced. Bus duct systems and cable trays may prove to be most flexible for areas in which new equipment is expected or that may have frequent modification. (5) 3-4-8. A recommended expansion capacity of 40 percent is usually provided.

Specifically refer to the "Electrical" portion of "Issues and Assumptions" portion of SB2, Vol. 2, for information relative to host nation power requirements. Additional information may be found in "guidance" of SB2 with respect to the standard frequencies and voltage levels used by various nations.

Provide host nation standard outlets if applicable.

guidance

Mechanical

The recommended operating temperatures and humidity conditions should be obtained from the manufacturers of the communications and data processing equipment and should be used in designing the environmental control system.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Inadequate cooling contributes as much to failure as poorly regulated power. (74) 4-17

Even though certain individual units can operate outside the limits of the overall specifications, overall environmental requirements are dictated by the most restrictive unit of the system. The computer system's requirements are the major considerations; however, good design will also consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in the following ways. (74) 4-17

- Heat dissipation by computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The number of air changes per hour varies between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Also, if the air-conditioning requirements are not met, a record must be available to indicate the extent and duration of the undesirable condition and indicate whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

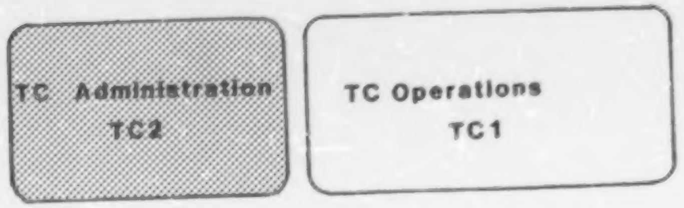
The record of temperature and humidity can be used to: (74) 4-25

guidance

guidance

guidance

TC ADMISTRATION TC2



function

To provide quality control, equipment management, and personnel training for technical control (TC) activities.

policy/sop

1. TC administration supports the TC area as a clearing house for:
   a. Training.
   b. Quality control.
   c. Equipment management:
      1. Equipment malfunction action--send out for major repair or replacement.
      2. Equipment testing action--make minor repairs in-house.
   d. Upkeeping manuals (for state-of-the-art information).
   e. Administration of a through d above.

issues and assumptions

1. Automated information

The use of a minicomputer with CRT and printout capability will streamline the administrative functions. Software programs are needed for:

- a. Master station--trunk history.
- b. Circuit layout records.
- c. Automatic analysis thresholds (total time and number).
- d. Trouble tickets.
- e. 551 Report (DCA reporting system).
- f. Training and rescheduling.
- g. Quality assurance information:
  - 1. Equipment (what is due for checkup?)
  - 2. Tasks (what has to be done?)

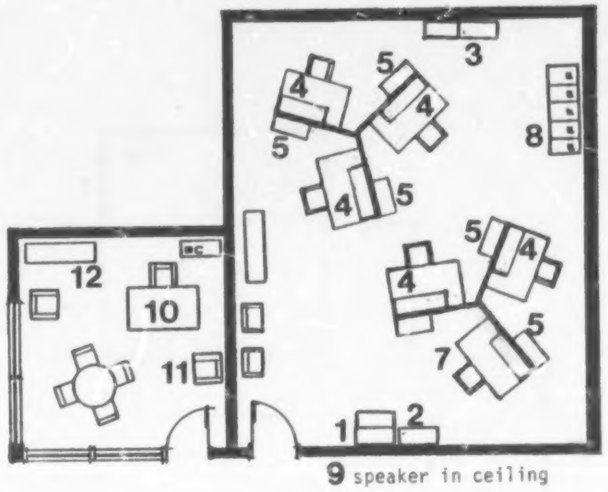
2. Terminating versus through station.

Terminating stations will have a much higher level of TC activities to maintain optimal subscriber service versus through stations where the receiving and retransmission of signals occur. Therefore terminating stations have a greater need for the individual workstations indicated for the administrative functions. For through stations, one noncommissioned officer (NCO) may serve in two or more specialty areas, e.g., as a combination training and quality control (QC) NCO.

activities	personnel	equipment
1. Controlling communication quality. 2. Analyzing communication equipment. 3. Testing communication equipment. 4. Developing personnel training plans and equipment evaluations. 5. Supervising shifts; making personnel assignments. 6. Coordinating training exercises. 7. Consulting with personnel. 8. Developing performance reports (APR).	1. Five NCOs: • Operations • Systems • Circuit actions • QC • Training	**1.** Test equipment. **2.** Test tools. **3.** Shelving for training manuals. **4.** Five desks with chairs. **5.** Five typewriters with stands. **6.** Telephones. **7.** CRT with printout capability. **8.** Files. **9.** Intercom speaker.
1. Supervising systems group. a. Distributing directives, orders, and policy statements, both written and verbal, to shift supervisors. b. Initiating evaluations of equipment capabilities.	1. Noncommissioned officer in charge--technical control superintendent.	**10.** Desk with chair (enclosed unit). **11.** Three side chairs. **12.** Bookcase, 12 linear feet. * see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Enough space to accommodate equipment and furniture associated with the administrative function.	**1.** Provide administrative space for supervisory personnel. This area varies with the number of assigned personnel, but is typically 700 to 800 square feet.	
2. Interior finishes suitable for durability, maintenance, and room function.	**2.** Floor--Carpet. Base--Glazed structural units, rubber, vinyl or comparable resilient material. Walls--Paint over concrete, gypsum board, or plaster. Ceiling--Acoustic tile.	**2.** See also Vol 2, SB2, Interior Construction and Finishes.
3. Acoustical isolation and attenuation for a nondisruptive environment.	**3.** The walls around the room should limit sound transmission to 40 decibels. Ceiling material should be rated at NRC .50 (minimum), floor surface at NRC .25 (minimum), and divider partitions (if used) at .85.	**3.** See reference 201, page 3-4, Table 3-2.
4. Adequate lighting.	**4.** Provide 80 footcandles for task lighting at work surfaces with 40 footcandles for the ambient level. Surface reflectances should be: • Ceilings--80 to 90 percent • Walls--40 to 60 percent • Floor--20 to 40 percent.	**4.** For further information on quality of lighting design using the ESI concept, see Vol 2, SB2, Electrical--Lighting.
5. Thermal regulation and other comfort features for the occupant.	**5.** Maintain temperature at 68°F (heating), 78°F (cooling), with 5 cubic feet per minute per person outside air ventilation rate. Provide a chair with seat height adjustment, casters, swivel, and independent back rest adjustment.	
6. Electrical power.	**6.** Provide 120/208 electrical service. 120-volt receptacles should be located for convenience at all workstations and workbenches at the appropriate height and every 10 linear feet of wall. Frequency levels should be 50 to 60 hertz ± 5 percent.	**6.** See also Vol 2, SB2, Communication Station Buildings--Electrical
7. Fire protection/life safety criteria are based on the assumption that this facility is windowless and, in addition, houses critical equipment and data that have a severe strategic fire loss potential.	**7.** Interior finish--Class A or B only. Corridor finish--Class A only. Automatic fire suppresion--Water sprinklers. Automatic notification/alarm--General alarm activated by the automatic suppression system and transmitted to the annunicator panel and local fire department or constantly staffed station outside the facility.	**7.** See Standardized Modules--Building Design Principles and Vol 2, SB3, Fire Protection/Life Safety, for more information.

guidance



guidance

1. Location

Windows to the outside are recommended for CONUS facilities on secure sites, such as military installations. OCONUS facilities usually should have a minimum of windows to limit opportunities for forced entry.

Activity subspaces

- Enclosed offices
- Workstations
- Filing area
- Reception.

3. Acoustical and visual privacy

Divider partitions between workstations should be 60 inches high (± 4 inches) to provide visual privacy while occupants are seated--and yet should not be confining. Circulation paths around workstations should minimize disturbances to other workstations.

6. Electrical power

Workstation divider partitions can be tackboard surfaces to display maps, job examples, service equipment, and other information. Floor-to-ceiling poles are recommended to distribute electrical and communication lines to workstation modules. This eliminates floor wires at circulation paths and allows future module modifications at minimal cost.

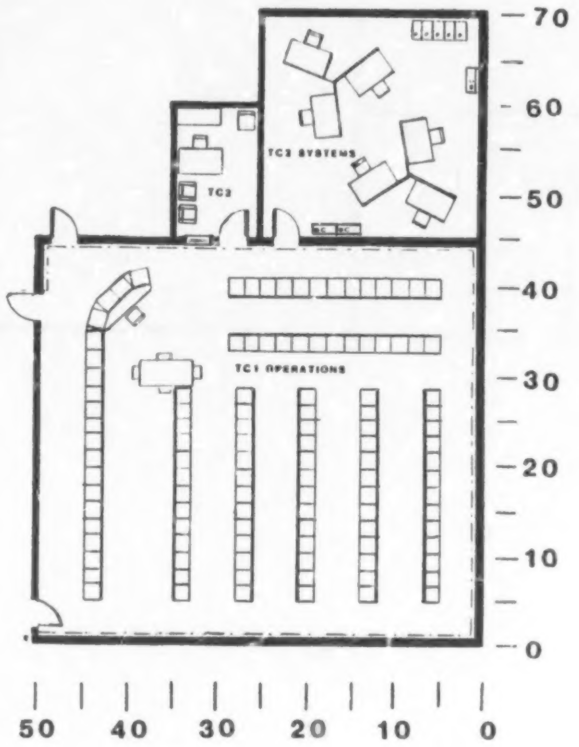
STANDARDIZED MODULES TC3

TC Administration
TC2

TC Operations
TC1

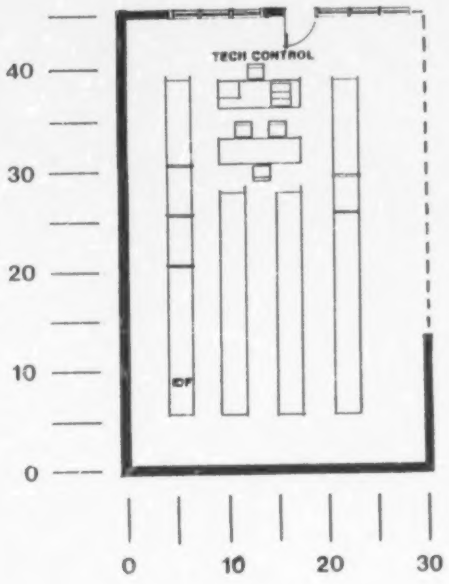
building design principles

The layout below shows technical control and systems modules as a part of a tropospheric scatter microwave radio transmission facility. See Volume 1A, TS15, for a total facility layout diagram and a list of typical building design principles.


TC3 SYSTEMS
TC2
TC1 OPERATIONS
70
60
50
40
30
20
10
0
50
40
30
20
10
0

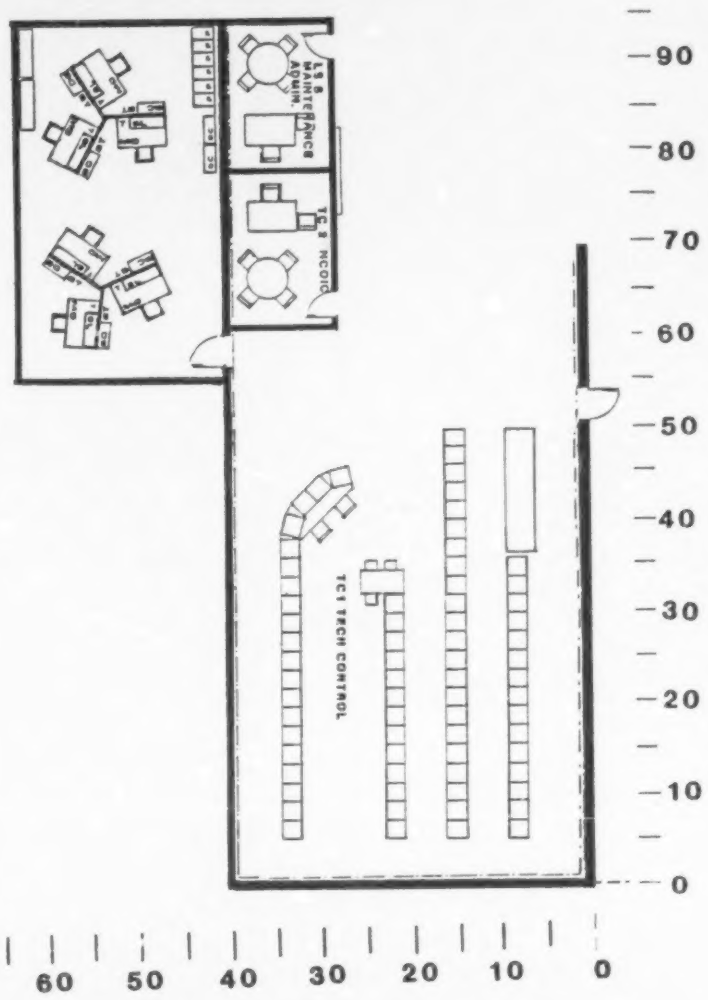
building design principles

The layout below is for technical control and systems modules as part of a high-frequency (HF) radio transmission facility. See Volume 1A, HF14, for a total facility layout diagram and a list of typical building design principles.


TECH CONTROL
IDF
40
30
20
10
0
0
10
20
30

building design principles

The layout below is for technical control and systems modules as part of a line-of-sight (LS) microwave radio transmission facility. See Volume 1A, LS15, for a total facility layout diagram and a list of typical building design principles.


LS & MAINTENANCE ADMIN.
TC & NCOIC
TC1 TECH CONTROL
90
80
70
60
50
40
30
20
10
0
60
50
40
30
20
10
0

Patch and Test (PT)

Patch and Test (PT) PT-1

PT1 Equipment/Control and Monitoring PT-2
PT2 Standardized Modules PT-8

EQUIPMENT/ CONTROL / MONITOR PT1

Equipment/Control and Monitoring
PT1

function

To support patch and test work. "Patch and test" refers to the monitoring of communication equipment to provide continuous operation with minimal loss of service and no loss of traffic.

To serve as an interface between various transmission and transmission/switching elements.

policy/sop

1. Communication security requires "general" filesafes. Top security information is filed in locked safes. When an emergency occurs, hard-copy information that is not already filed must be quickly placed into a "general" safe

issues and assumptions

1. Automated record keeping

CRTs with hardline printers can streamline paperwork by storing all circuit history files on disk. This will allow more rapid troubleshooting in-house.

2. Electromagnetic compatibility (2) 5-43

Electromagentic compatibility (EMC) is a complex subject, so that specialists often must perform the type of EMC study needed to insure the equipment or equipment layout produces no interferences or radiation hazard.

DOD is working on new regulations to control permissible levels of EM pollution of the frequency spectrum. This work reflects the concern for environmental protection. Radiation hazards also are being regulated through concern for occupational safety. Engineering agencies working for the Government must therefore know the legal and regulatory aspects of EMC and radiation hazards to meet these requirements.

Military specifications on EMC such as MIL-STD-461, -462, and -463 are intended to control and achieve an acceptable figure of merit or quality in the development of new communications equipment. They do not eliminate the need for EMC engineering in facility design. In addition to equipment quality, the frequency selection, nearness to other facilities and, to some extent, the facility design itself are variables in the interference generation problem. (2) 5-43

3. Determining the correct shielding procedure

A comprehensive approach to the shielding of equipment from radio-frequency interference (RFI) or TEMPEST involves (a) a building layout to optimize inherent facility shielding conditions, (b) suitable location of all electronic equipment and signal cables, and (c) selection of effective shielding materials and construction components.

See Vol 2, SB4, for additional guidance information.

activities

1. Monitoring communication equipment (patch and test).
2. Isolating fault.
3. Doing quality control maintenance tests.
4. Troubleshooting and patching to good equipment.
5. Identifying bad connections.
6. Writing and typing reports.
7. Conducting training sessions.

personnel

1. OPS NCOIC.
2. Two to six operators.

equipment *

1. Electronic communication system.
2. Patch bays.
3. Control console.
4. Workbench (6 linear feet) with shelving for manuals.
5. Desk with chair.
6. CRT at console.
7. Telephones.
8. Typewriter(s) or word processor(s).
9. Filesafe.
10. Electrical shock first-aid-kit.
11. Alarm panel.
12. Operational voice intercom control.
13. Record file (10 drawers).

* see "guidance" box for example layout of all equipment listed.

requirements	criteria	commentary
1. Adequate space for the operation and monitoring of communications-electronics (C-E) equipment. Spatial requirements must allow for proper spacing between equipment to facilitate easy maintenance.	**1.** Varies due to extent of communication equipment designed. See layout in Guidance.	
2. A secure environment for C-E equipment.	**2.** The operations room must be lockable when unstaffed and must be supplied with an intrusion alarm system. The operations console should be fitted with alarms for intrusion, power failure, and generator status. Covers should be provided on overhead rods for rapid sanitizing of applicable equipment.	**2.** See Vol 2, SB7, Security (Zone 3), for more information.
3. Signal shielding.	**3.** See Vol 2, SB4--Grounding, Bonding and Shielding along with SB7--Security Systems for more information.	
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5. Raised floor system.	**5.** Raised or false floors are necessary for proper cooling of the equipment.	**5.** See also Vol 2, SB2, Communication Station Buildings--Architectural.
6. Interior finishes suitable for durability, maintenance, and room function.	**6.** Floor--Vinyl asbestos tile panels. A raised floor system shall be used over a concrete floor with a dust-on finish that contains a hardener. See Vol 2, SB2--Interior Construction. Base--Glazed structural units, rubber, vinyl, or comparable resilient material. Wall--Paint over concrete, gypsum board, or plaster and acoustic tiles to within 4 feet of the floor. Ceiling--Acoustic tile.	**6.** See also Vol 2, SB2, Interior Construction and Finishes.
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9. Controlled environment for proper operation.	**9.** Maintain 70°F (±2°) and 50 percent relative humidity (± 5 percent continuously. Provide 5 cubic feet per minute per person outside air ventilation rate or the outside air quantity necessary to maintain a room pressurization requirement of .05 to .10 water gage.	**9.** See also Vol 2, SB2, Communication Station Buildings--Mechanical.
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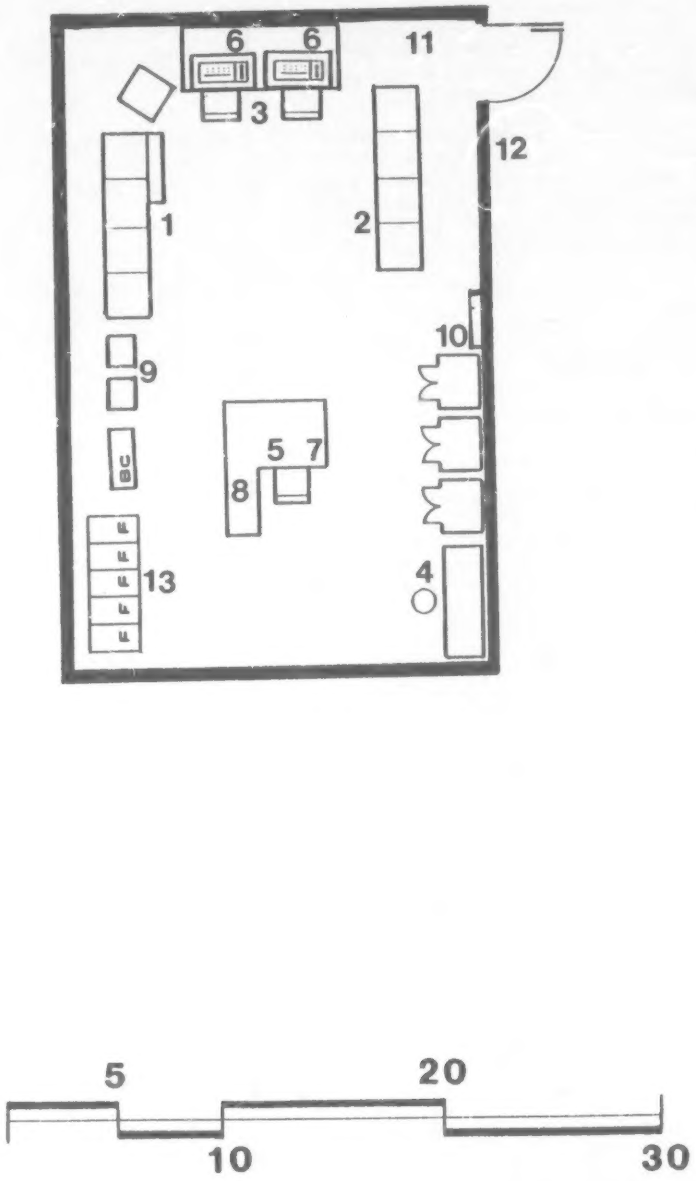
guidance



guidance

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5. Raised floor system

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Light fixtures should provide an approximate uniform lighting intensity of 70 footcandles and should be equipped with light control lenses or specular parabolic louvers to minimize glare on working surfaces. Lights over the area in which the control console is located shall be provided with wide-range (100:1) dimming control. (23)12

Equipment area

Fixtures should be arranged above the operating aisles and should run parallel to equipment row arrangement. They should be located so the light does not cast shadows or reflections on the front of the technical equipment and so light is not obstructed by the cable trays. Flush-mounted fluorescent lighting fixtures are recommended, and they shall be equipped with integral RFI filters (GE no. 89G635, Sprague IF-37, or equivalent). The lights shall not interfere with access to the cable trays or equipment. (23)12 Portable task lighting should also be supplied for the equipment area at 70 to 100 footcandles.

9. Protection from moisture migration

Operating spaces that contain electronic equipment usually require close temperature and humidity control. Vapor barriers placed under floor slabs and roofing usually prevent moisture migration into and out of interior electronic equipment spaces. Additional protection must be provided if exterior walls form part of the equipment space. (92)12.1-13

See also Vol 2, SB2, Special Mechanical.

guidance

Mechanical

The recommended operating temperatures and humidity conditions should be obtained from the manufacturers of the communications and data processing equipment and should be used in designing the environmental control system.

Air-conditioning

Continuous, reliable operation of any computer system depends on an efficient, well designed, properly controlled air-conditioning system. Inadequate cooling contributes as much to failure as poorly regulated power. (74) 4-17

Even though certain individual units can operate outside the limits of the overall specifications, overall environmental requirements are dictated by the most restrictive unit of the system. The computer system's requirements are the major considerations; however, good design will also consider personnel comfort. (74) 4-17

An air-conditioning system for a computer installation differs from ordinary comfort air-conditioning in the following ways. (74) 4-17

- Heat dissipation by computers is relatively constant; therefore, cooling is required year-round.
- The computer room sensible heat ratio is near unity because heat dissipated by the computer system is all sensible.
- Above-average air filtration is required to prevent errors caused by dust particles on magnetic tapes.
- The number of air changes per hour varies between 30 and 60 because of the computer equipment's high heat dissipation.
- Humidity control is required year-round to maintain necessary conditions in the computer room. However, introducing water vapor into the airstream for humidification is not recommended for electronic equipment areas because water vapor can damage electronic components. (40) 7-3

Temperature and humidity recording instruments

Recording instruments are needed to provide a continuous record of temperature and humidity in the machine area. Also, if the air-conditioning requirements are not met, a record must be available to indicate the extent and duration of the undesirable condition and indicate whether a drying-out period is required. In some cases, this may save machine shutdown time. (74) 4-25

The record of temperature and humidity can be used to: (74) 4-25

guidance

- Insure the air-conditioning system continues to perform its job properly. Installation errors and loss of efficiency due to malfunction of some air-conditioning system part can be detected quickly.
- Determine if a mandatory drying-out period is needed when humidity limitations are exceeded. Drying out may be necessary if the excess humidity occurs either during periods of actual operation or while the machine is shut down and unattended. The extent and duration of excessive humidity determines the length of the drying-out period.
- Determine if the environment meets requirements for the machine.

A visual or audible signaling device is desirable in the recording instrument. This is to provide visual or audible indication that temperature or humidity in the computer area is nearing the maximum limit.

Direct-reading instruments with a 7-day electric-drive chart are sometimes used in installations to monitor ambient room conditions. The recorder is usually located at a representative spot in the room and adjacent to the control devices.

For monitoring underfloor air conditions, a remote indicating instrument is recommended. This is usually a 7-day electric-drive chart and can be the wet-and-dry-bulb or electronic type if direct reading is not available. The recording instrument can be located on the wall in the operations room, in the mechanical equipment room, or in any other location convenient to the building engineer.

10. Electrical

Consider providing a flexible system that will meet the facility's future requirements. Electronic equipment is constantly being upgraded, modified, and replaced. Bus duct systems and cable trays may prove to be most flexible for areas in which new equipment is expected or that may have frequent modification. (5) 3-4-8. A recommended expansion capacity of 40 percent is usually provided.

Specifically refer to the "Electrical" portion of "Issues and Assumptions" portion of SB2, Vol. 2, for information relative to host nation power requirements. Additional information may be found in "guidance" of SB2 with respect to the standard frequencies and voltage levels used by various nations.

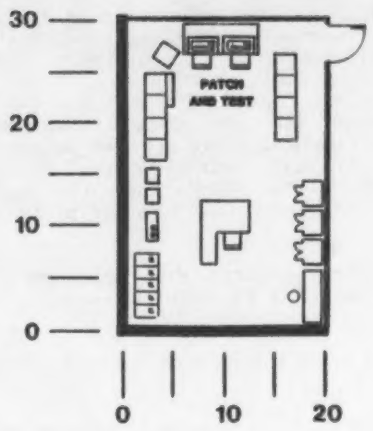
Provide host nation standard outlets if applicable.

STANDARDIZED MODULES PT2

Equipment/Control and Monitoring PT1

building design principles

The layout below is for a patch and test module as part of a regional control (RC) facility. See RC8 of this volume for a total facility layout diagram and a list of typical building design principles.



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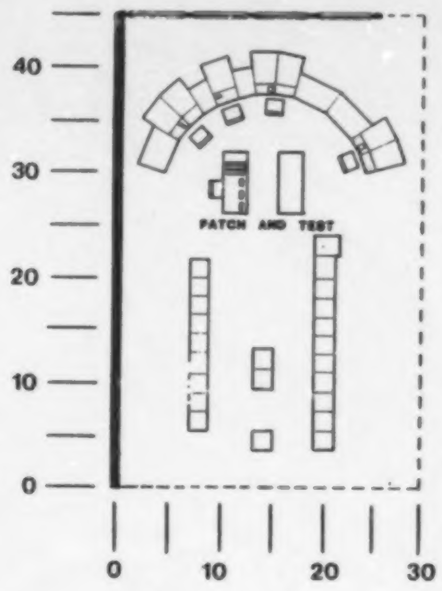
building design principles

The layout below is for a patch and test module as part of an AUTODIN facility. See ME24 in this volume for a total facility layout diagram and a list of typical building design principles.


40
30
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PATCH AND TEST
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building design principles

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*U.S. GOVERNMENT PRINTING OFFICE: 1985—557-014